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CIVIL ENGINEERING.

On Hollow Railway Axles. By J. E. M'Connell, of Wolverton.*

[Paper read at the Institution of Mechanical Engineers.]

The subject of railway axles was brought before this Institution on a former occasion by the writer, when he gave the result of various experiments, showing the form and dimensions most economical of material, with a proportionate and proper strength of the several parts, and also the changes in the structure of the iron which appeared to have taken place from various causes during the course of working. Since that period the writer's attention has been constantly directed to the subject, and the opinion he then expressed respecting the fractures of axles arising from changes from the fibrous structure of the iron, to a brittle, short-grained, or crystalline condition, has been confirmed by repeated instances which have come under his knowledge.

With the view of improving the strength and durability of railway axles—the two most important points for insuring the safety and security of railway traveling—the writer, after repeated experiments, and obtaining all the experience and information he could collect on the subject, arrived at the conclusion that the hollow or tubular axle combined in itself, if properly manufactured, all the properties necessary to secure the best form for lightness, strength, uniformity of structure in the material, elasticity to neutralize the injurious effects of blows and concussions, and consequent durability, from having a greater freedom from deteriorating effects.

The selection of the tubular form of axle originated from the knowledge, that with a considerably less weight of material in the form of the tube,

*From the Civil Engineer and Architect's Journal, October, 1853.

a much greater strength can be obtained to resist torsion, deflexion by pressure or weight, or concussion from blows. The resistance of a solid system to deflexion and torsion, increasing in proportion to the fourth power of the diameter (or the square of the square), but the weight increasing only as the square of the diameter, two solid cylinders, having the respective diameters of 4 and 5 inches, or 1 to $1\frac{1}{4}$, will have a proportionate weight of 16 to 25, or 1 to $1\frac{1}{2}$, but a resistance of 256 to 625, or 1 to $2\frac{1}{2}$. Then if a hollow of two-thirds the diameter be made in the larger axle, its weight will be diminished $\frac{1}{2}$ ($\frac{2}{3}\times\frac{2}{3}=\frac{4}{9}$ or $\frac{1}{2}$ nearly), and its resistance only $\frac{1}{5}$th ($\frac{2}{3}\times\frac{2}{3}\times\frac{2}{3}\times\frac{2}{3}=\frac{16}{81}$, or $\frac{1}{5}$th nearly), and the comparison with the smaller solid axle will then be 1 to $1\frac{1}{4}$ in diameter, 1 to $\frac{2}{3}$ in weight, and 1 to 2 in resistance, being double the resistance, with $\frac{1}{3}$th less weight.

The use of hollow axles was tried some years ago, but was not continued, the main objection being, that there appeared a great difficulty of insuring, by the particular mode of manufacture adopted at that time, a sufficient uniformity of thickness of the sides of the tube throughout, and also of the soundness of material. The mode adopted consisted of rolling two or three bars of a semicircular cross section, which were welded together with butt-joints, but with no internal pressure, and with solid ends where the bearings came. These axles, having no mandril or internal pressure during the process of welding, were found to be of a very uncertain strength throughout the axle, and the weakest point might be close to that part where the greatest force or strain would be exerted.

To overcome these objections, a mode of manufacturing railway axles has been introduced by the writer, which, it is believed, effectually accomplishes the object in view, securing the utmost strength with the least possible amount of material, uniformity of structure of the iron, perfect equality of thickness of material, and soundness of manufacture.

Fig. 1.

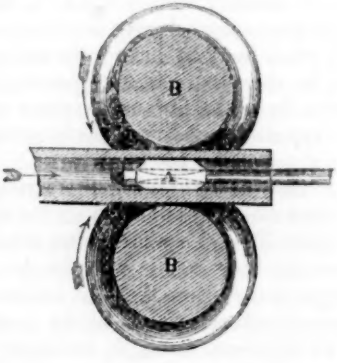

Fig. 2.

The plan adopted is as follows:—A number of segmental bars of the best quality of iron are rolled to a section, so as to form, when put together ready for welding, a complete cylinder, fig. 1, about $1\frac{1}{2}$ times the diameter of the axle when finished, the bars fitting correctly together, so as to

have no interstices, and overlapping in such a manner as to insure a perfect and sound weld when completed, as shown in fig. 1.

This cylinder of loose segmental bars is temporarily held together by a screw-clip, and each end being put into the furnace until a welding heat is produced, the bars are then partially welded together, and the clip removed. The whole cylinder is then placed in the furnace, and brought to a proper welding heat; it is then passed through a series of rollers, B, B, fig. 2, which have each a mandril of an egg-form, A, in the centre of the circular openings, which are attached and supported on the end of a fixed bar, the bar being firmly secured at the opposite end, to resist the end pressure or strain during the process of rolling. The mandrils are made of cast iron, chilled, fitting on like a socket on the end of the bar to a shoulder, and they are secured by a screw-nut, so that they are easily removed when required.

The motion of the rolls is so arranged, by a reversing-clutch on the shaft, that as soon as the axle-cylinder has been drawn clear through, the motion is reversed, and the axle, which has been drawn on to the mandril-rod, is again drawn back through the same opening in the rolls; it is immediately passed through the next smaller groove of the roll, with a decreased size of mandril, and again reversed back through the same groove in a similar manner, and so on through a series of grooves in quick succession, each decreasing in size, and consequently increasing the compression and strength of the iron of which the axle is formed, and by the last groove it is passed through it is reduced to the proper diameter. At each time it is changed from one groove to another, the axle-cylinder is turned by the workman a quarter round, so as to equalize the pressure on every part of its surface, to insure uniformity of the compression of the iron, and thoroughly complete a sound welding throughout every part of the axle.

The specimens before the meeting showed the soundness and perfection of the manufacture, as a proof of which, in every test applied, either by blows on the outer surface or by an immense splitting pressure, by driving a mandril in the interior, there has never been found in any one instance a failure of the weld, although the test has been applied to pieces cut off the extreme end, where it might be supposed the welding of the cylinder of the axle, from various causes, would not have so good a chance of being perfect.

The axle at this stage, after being welded and drawn down in the rolls to the proper size, is taken at once to a hammer, where it is planished between semicircular swages over its entire surface. A small jet of water plays upon it during this process, which enables the workman to detect at once, by the inequality of color, any unsoundness in the welding. From the hammer it is taken to the circular saws, where it is cut accurately to the length required, and ready to have the bearings formed upon it.

On coming from the hammer, the axle is found to be perfectly clean both inside and outside, the scale being entirely removed. The ends are then re-heated, and gradually drawn down by a hammer to the proper dimensions and form of the journals, a mandril being inserted in the end of the tube during the process of hammering.

The formation of the journals can also be produced by a rolling machine, constructed of tables the entire length of the axle, rolling transversely, each table being a duplicate of the other, and matrices of the axle when finished. Or in another way, by two sets of rollers, each set consisting of three rollers running vertically, being of the same diameter, and driven at the same velocity, formed exactly to the shape of the bearing, and set the proper distance apart from shoulder to shoulder of the journals.

The manufacture of these axles has been intrusted to the Patent Shaft Company, and a great amount of credit is due to Mr. Walker, the managing partner of that firm, for the very excellent system he has adopted and carried out in the process of manufacture.

As an illustration of the saving in dead weight, take, for instance, a railway employing 15,000 wagons and carriages, and assume each of these vehicles to run on an average 10,000 miles per annum. The weight of two axles of the solid description finished, say 5 cwt., and if replaced with hollow axles of equal strength, the weight per vehicle may be reduced 1½ cwt.; this taken over one mile of the above stock per annum will be 11,250,000 tons, and assuming the cost of traction for locomotive power at ¼*d.* per ton per mile, the saving will amount to 11,700*l.* per annum, without taking into account the other advantages, and also the saving to the permanent way, &c.

In the samples of axles submitted to the meeting, two different kinds of bearings were shown, the parallel bearing with the rounded shoulder, and also the double conical bearing, such as is used on the Great Northern, Great Western, Bristol and Exeter, South Wales, and South Devon Railways. In either description of bearing, the hollow axle is good, although it is believed that the conical bearing for *either* the solid or hollow axle has less tendency to injure the texture of the iron during the formation of the journal than the parallel shouldered axle, and it appears a matter well deserving the consideration of the Institution, to ascertain what, under all conditions, is the best form of axle bearing.

Experiments, conducted by Mr. Marshall, the Secretary of the Institution, have been tried for the purpose of ascertaining the comparative strength of the hollow and solid axles to resist a transverse strain. Each axle was supported on massive cast iron blocks, fixed at a distance of 4 feet 11 in. apart, to represent the support given by the rails to the axle. A cast iron block weighing 18 cwt. was then let fall on the centre of the axle from a height of 12 feet, and the extent of bending was measured. The axle was then turned half round, and another similar blow given on the opposite side, bending it in the opposite direction. This proceeding was repeated until the axle was broken. The general results of these experiments are as follows:—

An *Old Solid Axle*, 3¾ inches diameter in centre, 4¼ inches at ends, which had been at work three years, was bent 8¾ inches by the first blow; it was nearly straightened by the second blow in the opposite direction, then bent 10 inches by the third blow, and with the sixth blow it was broken in the centre square across.

A *New Solid Axle*, of the same dimensions, was bent 9¾ inches by the first blow, then nearly straightened by the second blow, and bent 9½ inches

by the third blow, and by the fourth blow 2½ inches, and by the fifth blow it was broken ⅞-inch from the centre. The appearance of the fracture was crystalline over three-fourths of the section, the remaining part tough fibre.

A *New Hollow Axle*, 4⅜ inches diameter throughout, was bent 5 inches by the first blow, nearly straightened by the second blow, and bent again 5 inches by the third blow. The ninth blow bent it 4½ inches, and the tenth blow 1⅜ inch. Up to the fifteenth blow it was bent alternately, the bends varying from 2 to 3½ inches. There was no appearance of failure or cracking, but a slight rising of the surface at the fifteenth blow. The blows were continued to the twenty-seventh, the bends varying from 2 to 3⅝ inches, and at this blow a fracture took place across the middle of the axle 1½ inch long. The twenty-eighth blow bent it ⅜-inch, and closed the fracture on the opposite side made by the preceding blow. By the twenty-ninth blow it was fractured two-thirds through, and bent 9½ inches, the appearance of the fracture being very fibrous.

A second series of experiments was made, to ascertain the comparative strength of the journals of the hollow and solid axles to resist breaking.

Each axle was supported on an anvil, with the inner shoulder of the journal projecting 1½ inch beyond the edge of the anvil, to represent the support of the axle in the nave of the wheel; 100 blows with two 24 lb. sledge-hammers were then struck upon the upper side of the outer end of the journal, the men being changed after striking each twelve or thirteen blows alternately. The amount of bending of the journal was then measured, and the axle turned half over, and another 100 blows similarly given on the opposite side of the journal; the same proceeding being then further repeated. The general results of these experiments are as follows:

An *Old Solid Axle*, with 3 by 5 inch journals, that had been at work three years, had one journal broken off with 205 blows, and the other with 53 blows; both fractures were square across the journal at the shoulder.

A *New Solid Axle*, with 3 by 6 inch journals, had the journal broken off with 570 blows, the fracture being irregular in form, and fibrous.

A *New Hollow Axle*, with 3 by 5 inch journals, had 400 blows on the journal, which bent down the end ⅝-inch, and produced a longitudinal split on the under side 3¾ inches long, but no transverse fracture.

A *New Hollow Axle*, same size journals, received 800 blows on the end of the journal, which bent it down ⅛-inch, and split the journal longitudinally on both sides, but caused only a slight transverse crack near the shoulder, ¾-inch long.

The experiments on transverse strength by a heavy weight falling on the centre of the axle, and giving the blow on opposite sides alternately, show that the hollow axle is nearly double the strength in that respect of the corresponding solid axle, the amount of bending being only 5 inches instead of 9¾ inches; and the number of blows required to break the hollow axle being 29, whilst the solid axle broke at the fifth blow, shows the hollow axle to be greatly stronger in resistance to fracture.

The hollow axle became ⅛-inch oval in the centre after receiving the seventh blow, and it was only ¼-inch oval after receiving the twenty-

eighth blow just before fracture; being bulged outwards $\frac{1}{16}$-inch at each side, and $\frac{1}{16}$-inch inwards at top and bottom from the original circular section.

The experiments on strength of journals show, that instead of the journals breaking off square and short at the shoulder, as in the solid axles, the hollow-axle journals stand a considerably greater number of blows, and then only split up longitudinally, instead of breaking off transversely, being a very important advantage in point of safety in working.

In the course of the discussion which followed the reading of the paper, it was remarked, that in the fracture of the hollow axle all the iron appeared fibrous, but the fracture of the solid axles was mostly crystalline; that the saving in weight of the hollow axles was about two-fifths theoretically to obtain the same strength, but it had been taken at one-third of the solid axles, to be on the safe side. The hollow axles were being extensively applied on the North-Western, Midland, and Great Northern Railways, and more than 500 had already been made; some had been at work for nine months with entire satisfaction.

Mr. M'Connell observed, that whatever was the nature of the strain, and the change produced by concussion, the effect of the continued blows and concussion to which a railway axle was subjected, must be greatly diminished when the axle had a large hollow through the centre, instead of being entirely solid, as the effect of a blow on one side would be mostly lost in the vacant space of the centre, instead of being all communicated through the mass of the axle. He showed specimens of a hollow and a solid axle, which had been run hot for two hours without oil in a lathe, at a speed corresponding to about twenty miles an hour traveling; the solid journal broke off with 179 blows quite short and crystalline, but the hollow journal would not break transversely and split longitudinally in several places with 400 blows, and did not appear injured.

Mr. Adams said, he thought the conical journals were preferable to the ordinary cylindrical ones, and they were particularly adapted to the manufacture of the hollow axles, by avoiding the sudden shoulder. He had found the conical journals less liable to heat than the others when well fitted; in the cylindrical journals, as square shoulders were found preferable in practice to shoulders much rounded, it was important to maintain a uniform strength of metal at the shoulder.

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*English and American Railways.**

We alluded last week to the average cost of a mile of railway in New York State. This is given at 36,701 dollars, or £7500 per mile of single line, including sidings, locomotive and working stock, &c., &c. This average is, however, higher than that of other American states, and is caused by the high charges for the Rochester and Syracuse, 104 miles long; the Hudson River, 144 miles long; the Albany and Schenectady, 17 miles long; the Troy and Greenbush, 6 miles long. These cost about 50,000 dollars, or £10,400 per mile. The New York and Erie, however, 461½ miles, cost nearly as much, namely, 50,344 dollars, or £10,488 per mile.

*From Herapath's Journal, No. 734.

The cost of several of the lines is much below these rates. The dollar we have reduced, as before, at the rate of 50 pence.

	Length miles.	Dollars.	£.
Northern,	118	35,110	7310
Troy and Bennington,	5	33,856	7050
Buffalo and Rochester,	76	32,295	6740
Saratoga and Washington,	53	31,439	6540
Schenectady and Troy,	20½	31,160	6480
Troy and Boston,	26	30,391	6330
Rensselaer and Saratoga,	25	29,226	6090
Chemung and Susquehanna,	17¼	28,225	5880
Cayuga,	35	28,178	5870
Buffalo and State line,	69	25,963	5400
Hudson and Berkshire,	31½	25,364	5290
Syracuse and Utica,	53	23,346	4860
Utica and Schenectady,	78	23,257	4840
Long Island,	95	22,089	4600
Buffalo and Niagara,	22	20,568	4280
Saratoga and Schenectady,	22	20,502	4270
Canandaigua and Elmira,	46¾	20,259	4220
Watertown and Rome,	96	16,364	3390
Oswego and Syracuse,	35	15,787	3290
Buffalo and Corning,	44	14,751	3080
Plattsburg and Montreal,	23	14,573	3030

The latter items £3030 to £3390, are as much below the usual rates, as those of £10,000 per mile are above it; nevertheless, it is evident, a line nearly 100 miles, like the Watertown and Rome, can be constructed and equipped for £3400 per mile.

It will be useful to examine the various classes of expenditure. We shall begin with the heaviest, and take the New York and Erie, which is an example of a long line, extending 464½ miles. The cost is thus made up:—

	Dollars.	£.
Land, damages, and fencing,	1,968	410
Earthworks, bridges, &c.,	19,482	3966
Permanent way and rails,	8,763	1825
Stations,	1,915	398
Engineering, and preliminary expenses,	869	185
Total cost of line,	32,997	6870
Locomotives, carriages, &c.,	17,347	3618
Total cost,	50,344	10,488

The figures will not fit exactly, but they will be found sufficient for any useful comparison.

A large class of lines are constructed at about 30,000 dollars per mile. We will take the Buffalo and Rochester at 32,295 dollars.

	Dollars.	£.
Land and fencing,	5,228	1090
Earthworks, &c.,	7,000	1458
Bridges,	721	150
Permanent way, &c.,	14,172	1942
Stations,	623	130
Shops and machinery,	409	85
Engineering, &c.,	179	37
Total cost of line,	28,332	5902
Locomotives, carriages, &c.	3,963	839
Total cost,	32,295	6740

Another class of lines are those at 20,000 dollars. We shall take the Long Island Railway.

	Dollars.	£.
Land and fencing,	1,029	214
Earthworks, &c.,	6,203	1292
Bridges,	134	28
Permanent way, &c.,	10,908	2271
Stations,	120	25
Shops and machinery,	424	88
Engineering, &c.,	891	186
Total cost of line,	18,710	3897
Locomotives, carriages, &c.,	3379	703
Total cost,	22,089	4600

We shall now take the cheapest lines, the example being the Watertown and Rome, 96 miles long.

	Dollars.	£.
Land and fencing,	1,083	225
Earthworks, &c.,	6,413	1,335
Bridges,	407	84
Permanent way, &c.,	5,480	1,141
Stations,	377	78
Shops and machinery,	239	49
Engineering, &c.,	399	83
Total cost of line,	14,399	2,999
Locomotives, carriages, &c.,	1,965	408
Total cost,	16,364	3,407

The actual cost of construction of the several lines, is as follows:—

	Dollars.	£.
New York and Erie.	32,997	6870
Buffalo and Rochester,	28,332	5901
Long Island,	18,710	3897
Watertown and Rome,	14,399	2999

The cost of working plant is as follows:—

	Dollars.	£.
New York and Erie,	17,347	3618
Buffalo and Rochester,	3,963	839
Long Island,	3,379	703
Watertown and Rome,	1,965	408

The difference of cost between the New York and Erie, and the Buffalo and Rochester, is chiefly owing to the difference of cost of working plant, the former requiring for its heavier traffic more plant.

The work is regulated according to the traffic, and when the traffic admits of it, the works are of a larger and more expensive class, the rails heavier and the plant stronger.

The total length in New York State laid at the lowest rates, is 198 miles, and ranging from £3090 per mile, to £3390 per mile. In the teeth of such figures, it is impossible to say lines cannot be laid down in our colonies and India.

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*Trial of the Boomerang Screw Propeller.**

On Saturday last at half past seven, A. M., a trial trip with Sir Thomas Mitchell's boomerang propeller took place in Stoke's Bay, along the

* From the London Mechanic's Magazine, July, 1853.

measured mile, on board Her Majesty's ship *Conflict*, under the command of Captain Henderson, C. B., of Her Majesty's ship *Blenheim*.

The wind was strong at the time the *Conflict* reached her trying ground, amounting to from six to seven, or equal to about a quarter of a knot. The tide was opposed in one direction of the course, the wind in the other. After eight runs along the measured distance, the results were, on an average, 9·125 knots, with an average of 63¾ revolutions. This was somewhat surpassing in speed the result of the last trial with the common screw, with eight revolutions less, and a saving of one-eighth of the coal; and Sir Thomas Mitchell appeared to entertain no doubt that, had the pitch of the boomerang screw been the same as the pitch of the common screw, a higher speed would have been the result. The reduction of the vibration ordinarily experienced on board either screw or paddle steamers, and frequently a distressing annoyance, was noticed approvingly by all on board the *Conflict*. This comparative absence of vibration is one of the best characteristics of the boomerang, saving at once the wear and tear of the ship and the passengers' rest. The *Conflict*, however, is not a vessel the construction of which admits of her rapid propulsion, either by steam or canvas, as her trials in Commodore Martin's squadron, as set forth in the official report, sufficiently testify. This heaviness of the *Conflict* clearly accounts for the less brilliant result as to speed obtained with the boomerang than was formerly obtained with it at Liverpool and Sydney, on board vessels built on lines better adapted for speed. We were informed by one of the owners of the *Genova* (a Liverpool merchant ship, of which we noticed the trial with this propeller,) that on a recent voyage home from Quebec to Liverpool, the *Genova* had averaged a knot more per hour with the boomerang propeller than he had ever previously attained with a common screw, with not half the customary vibration.

The name "Boomerang" propeller has incited many inquiries as to what affinity, in nature as in name, this screw of the scientific Australian engineer and discoverer, Sir Thomas Mitchell, claims with the familiar though little understood missile of that name, of which such marvellous stories are told. In the hands of a native the boomerang certainly performs marvellous feats, while in those of an European it is inert or intractable. The savage, by practice, knows precisely how to poise as well as project his familiar missile, and in this secret, we apprehend, consists Sir Thomas Mitchell's application of the principle of the Australian missile to the propulsion of vessels. The balanced centre is the great feature connecting Sir Thomas Mitchell's screw and the boomerang, and upon this principle, judging by analogy, the efficiency of the arrangement very much depends. Other trials with Sir Thomas Mitchell's propeller are in contemplation, when we shall further notice the results obtained.

Another trial took place on Monday morning last. The *Conflict* left harbor at 9 A. M., for the measured mile in Stoke's Bay, when the average result of six runs was 9·378 knots, an improvement of about two-thirds of a knot on the speed attainable with the *Conflict's* own propeller. The average revolutions were 65½.

This trial with the boomerang was made in order to test the action of the blades, after the two small continuations which Sir Thomas Mitchell

had been induced to make had been taken off, and the propeller reduced to its original shape and proportions. The result has been a gain of two-thirds of a knot, which nautical men consider a great deal with so heavy a ship as the *Conflict;* and we understand that Sir Thomas Mitchell means to challenge Griffith's propeller to do as much with the same ship.

The general result of the trials to which the boomerang has been subjected, seem to establish its claim to public favor. In point of celerity, Sir Thomas Mitchell has proved the efficiency of his boomerang in a very heavy vessel, and that efficiency will be more palpably manifest if his offer to fit one to Her Majesty's yacht the *Fairy* is accepted. In other points not so striking to superficial observers, perhaps, as celerity, but not less intrinsically important, namely, the diminished wear and tear of ships and the economy of fuel, the superiority of the boomerang is decided. We alluded to the absence of vibration in the trial we last reported; and on this occasion, in the midships of the vessel and below, while the *Conflict* was making nearly 10 knots, vibration could not be perceived. The enterprising merchants of Liverpool have shown themselves sensible of the economical advantages of the boomerang, and have already fitted it to several of their ships, which have accomplished quick voyages with a much diminished expenditure, as already noticed. The propeller used on board the *Conflict* was manufactured by Taylor & Co., of Birkenhead, and Sir Thomas Mitchell pronounced an emphatic eulogium on the skill of their workmen, and their ready appreciation of the principle of his invention, or rather his ingenious application of the principle of the rude Australian weapon to the purposes of propulsion. The leading and the following blades of the boomerang propeller may be likened to the dorsal and caudal fins of fishes when swimming, act on water at similar angles, and are rooted on the shaft on the same principle of strength as those fins are attached to the fish's body, imparting the power which is to give it motion. To give the boomerang propeller full space to develop its powers, larger apertures are requisite than are now generally found in either ships of the royal navy or in merchant vessels. The full boomerang propeller requires, we are informed, a space in length equal to one-third of the height. This alteration can, however, be easily effected.

AMERICAN PATENTS.

List of American Patents which issued from October 18, *to November* 8, 1853, (*inclusive,*) *with Exemplifications by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

OCTOBER 18.

63. For an *Improvement in Propellers;* Ebenezer Beard, New Sharon, Maine.

Claim.—"What I claim is, the use of one or more flanches or arms, placed circumferentially upon the blades of a screw propeller, substantially in the manner and for the purpose described."

64. For an *Improvement in Sofa Beds;* Edwin B. Bowditch, New Haven, Conn.

"My invention consists in arranging the ordinary seat of a sofa, lounge, or other suitable article of furniture, and in such a manner that it can be turned up and back far enough to allow an under seat, which is hinged to the front rail of the sofa, with the upholstered

side down, to be turned out to the front, so as to come on a level with the ordinary seat, when said ordinary seat is let back into its place, thus forming a level bed."

Claim.—"What I claim is, the arrangement of hinging the ordinary sofa seat to the back rail of the sofa frame, in combination with the arrangement of hinging an under seat with the upholstered side down, to the front rail of the sofa, so that said under seat, by lifting the ordinary seat back, can be turned out of the front of and on a level with the ordinary seat, thus forming a bed. I also claim the arrangement of hinging the stuffed back to the top rail of the sofa, and attaching the back, at the bottom, to the top seat by strips of iron, in combination with the arrangement of hinging the top seat at the back lower corner."

65. For an *Improvement in Shuttle Motions for Power Looms;* William Crighton, Fall River, Mass.

"This invention consists in connecting the two pickers by means of a rigid rod or connexion passing through the lay, and giving motion to the same by a picker lever, which is operated upon to throw the shuttle in both directions by a single cam. The result obtained by this improvement is, the giving of the pickers a perfectly parallel motion, by simpler mechanism than that commonly employed for the purpose."

Claim.—"I do not claim operating the picker by a cam on a short shaft at the side of the loom; but what I claim is, connecting the two pickers with a rod or rigid connexion, which receives motion from a single lever and one cam, whereby both pickers are operated, as herein set forth."

66. For an *Improvement in Attaching Artificial Teeth to the Metallic Plate;* Henry L. Crider and David Williams, Lancaster, Ohio.

Claim.—"What we claim is, securing the artificial teeth to a plate by the usual method, and afterwards fastening said plate on the alveolar ridge of the plate having the impression of the mouth, either by riveting or the employment of soft solder, so as to prevent the application to the plate (having the impression) of the intense heat required to secure the teeth, as and for the purpose fully set forth."

67. For an *Improvement in Self-Winding Telegraphic Registers;* James J. Clarke, Philadelphia, Pennsylvania.

Claim.—"What I claim is, the combination of the winding magnet, the break-circuit wheel, and spring, with the train of wheels of an ordinary telegraph register, in the manner and for the purpose substantially as described."

68. For an *Improved Steering Apparatus;* Charles Flanders, Boston, Mass.

Claim.—"What I claim is, my combination and arrangement of the rope, the two sets of leading blocks, the sheaves in the after end of the tiller, with one another, the tiller and windlass, so as to operate together, and move the rudder, substantially in the manner, as specified."

69. For an *Improved Mode of Operating Mill Saws;* Benjamin Frazee, Durhamville, New York.

Claim.—"What I claim is, attaching a reciprocating saw blade to the main shaft, by means of a slotted lever and crank pin, operating in the manner and for the purposes substantially set forth."

70. For an *Improvement in Machines for making Railroad Chairs;* Robert Griffith, Newport, Ky., and Geo. Shields, Cincinnati, Ohio.

Claim.—"What we claim is, 1st. Hanging the fulcra of the clipping and bending levers eccentrically in boxes made capable of circular movement, for the purpose of adjusting the said levers to their work with facility and accuracy, substantially as specified. 2d, The method described of adjusting the angular set of the clipping and bending levers, by pivoting and adjustably connecting them to outer operative levers, essentially as set forth, and whereby a varied inclination may be given to the cutting and bending of the clip, to suit different thicknesses of blanks or forms of chair required."

71. For an *Improvement in Implements for Cutting Cloth;* Geo. W. Griswold, Carbondale, Pennsylvania.

Claim.—"What I claim is, stretching the cloth or other material to be cut over the two jaws of the stock, and holding it firmly in place by the clamp, whilst the knife divides it with a draw cut, substantially as described."

72. For an *Improvement in Instruments for Plotting;* Thomas Hinkley, Hallowell, Maine.

Claim.—"What I claim is, the method or means of obtaining in the above described machine a compound or resultant parallel motion, the same consisting in a combination of pinions or gears, and sunken racks, (or racks provided with parallel bars, as specified,) two sliding and rotary shafts, as arranged, connected, and supported, so as to operate together, substantially as described."

73. For an *Improvement in Cutting Boots;* Daniel Lynahon, Buffalo, New York.

Claim.—"What I claim is, the tongue, which first gives to the vamp a more exact crimped turn; secondly, covers the seam from being seen, and prevents it from ripping; and, thirdly, keeps the seams permanent, by receiving the strain that comes on them when drawing on the boot."

74. For an *Improvement in Power Looms;* William Mason, Taunton, Mass.

Claim.—"What I claim is, the method of operating the warp beam to let off the warps, and ease them in the opening of the shed, by means of the weighted cord acting on the periphery of a wheel geared to the warp beam, and receiving motion from an eccentric or its equivalent, substantially as specified, in combination with the mode of regulating the delivery motion by the action of the warps on a weighted whip roller, acting by a friction strap on the friction wheel on the let-off apparatus, substantially as and for the purpose specified."

75. For an *Improvement in Machines for Figuring Carpenters' Squares;* Norman Millington and Dennis J. George, Shaftsbury, Vermont.

Claim.—"What we claim is, the combination of the revolving chase wheel with the lateral moving anvil, by which the relative position of the square to be stamped and the required chase is so regulated that the line of the square to receive the impression is brought under the chase containing the desired figures, substantially as set forth."

76. For an *Improvement in Power Looms;* John Pender, Worcester, Mass.

Claim.—"What I claim is, the rest, in combination with the guides, when constructed substantially as described."

77. For an *Improvement in Looms for Weaving Fancy Goods;* Benjamin F. Rice, Clinton, Mass.

"The nature of my invention consists, first, in employing levers formed of two or more parts, one part of said levers being so constructed as to oscillate within the other part by the action of hooks and pins set in the grooves of a figuring chain, said hooks and pins acting upon the upper portion of the oscillating part of said levers, thereby causing the lower portion of the aforesaid oscillating part to move to and fro within the outer and larger part of said levers, thus forming a groove in which a vibrating roller is made to act upon the outer and larger part of said levers, which operation raises and depresses the harnesses in the manner hereafter to be described, whereby I am enabled to give a more positive action to the levers which act upon the harnesses when run at an unusual speed, and also to produce a uniform shed. The second part of my invention consists in giving motion to the figuring chain, by the use of a crown wheel turned by the action of a finger projecting from a vibrating lever, and working in the openings of the crown wheel, said vibrating lever receiving its motion from a crank connected to a disk wheel on the outer end of the main or crank shaft, thereby giving a positive motion to the figuring chain which carries the hooks and pins, and also to reverse the motion of the chain without the loss of the figure, when the main or crank shaft is reversed. The third part of my invention consists in constructing the bars which connect the links of the figuring chain in such a manner as to admit of the insertion of hooks or pins, the lower parts of which are made in the form of an inverted wedge; said bars are also provided with a slot or opening at one end, large enough to admit easily the insertion of the hooks or pins; the advantage thereby obtained is, that the hooks or pins are more easily adjusted, and also held more firmly in their position when placed."

Claim.—"Having described the construction and operation of my invention, and pointed out its modification, what I claim is, the application of compound levers, constructed substantially as herein described, to the raising and depressing of harnesses or heddles in the manner substantially as set forth. I also claim employing a finger attached to the vibrating lever, operating substantially as described, in combination with the crown wheel,

to move the figuring chain, substantially as specified. I also claim forming a groove in the bars of the figuring chain, for the insertion of hooks or pins, or their equivalents, in the manner substantially as specified."

78. For an *Improvement in Air Beds;* John Scott, Philadelphia, Pennsylvania.

Claim.—"What I claim is, forming a bed of an air-tight india rubber cloth sack, enclosed or enveloped in a pouch-formed mattress, composed of two thicknesses of ticking or other suitable material, between which is interposed feathers, hair, cotton, or other soft substance, retained by proper quilting; said mattress conforming to the shape and size of the air sack when extended with air by flexible pipes."

79. For an *Improved Life Preserving Bucket;* Nathan Thompson, Jr., Williamsburg New York.

Claim.—"I do not claim a double vessel, as such have been employed both as refrigerators and retainers of heat; but what I do claim is, 1st, A double vessel, the space between the outer and inner side thereof being filled with cork or its equivalent, by which it is in a great measure secured against leakage, and retains sufficient buoyancy when punctured, and serves as a reliable bucket and life preserver. 2d, I claim attaching the handle thereto by means of the tubes, the nicks in the handles, and the bending of the ends of the tubes therein, substantially in the manner described."

80. For an *Improved Life Preserving Seat;* Nathan Thompson, Jr., Williamsburg, N. Y

Claim.—"I do not claim a life preserving stool or seat in the general, as such have been for a long time in ordinary use; but what I do claim is, 1st, The folding life preserving seat, with a buoyant divided top, constructed substantially in the manner described. 2d, The clasp, in combination with the surfaces on which it slides, constructed substantially as described, and operating to hold the stool either shut or open, substantially as described."

81. For an *Improvement in Iron Car Bodies;* Thomas E. Warren, Troy, N. Y.

Claim.—"What I claim is, the combination of the hollow sheet metal columns and panels, as described, with the through bolts, holding the top, bottom, and sides all firmly together, in the manner and for the purpose set forth."

82. For an *Improvement in Carpet Stretchers;* J. W. Weatherby, Kingsville, Ohio.

Claim.—"I do not claim the invention of rack and pinion, or any of these parts separately of themselves, but the general construction and arrangement, by which I am enabled to save much time and labor, and also to perform the object in a more perfect manner than it can be done in the usual way. But what I do claim is, the general construction and arrangement of the carpet stretchers, made and operated as described."

83. For an *Improvement in Door Locks;* Linus Yale, Newport, New York.

Claim.—"What I claim is, introducing and applying the key from behind, instead of in front, as is usual, by means of a permanent wrench, revolving key, chamber, and the passage, in the manner and for the purpose substantially the same as described."

84. For an *Improvement in the Application of High Pressure Engines to Screw Propellers;* Harry Whitaker, Buffalo, N. Y.

"The nature of my improvement consists in applying screw propellers and engines therefor to the sides of boats, in such manner that they can be worked by the direct application of the crank from the engine."

Claim.—"What I claim is, the direct application of the crank outside of the hull to side screw propellers, when such application is combined with or effected by a high pressure engine, arranged also outside of the hull, substantially as above set forth."

OCTOBER 25.

85. For an *Improved Window Shutter and Fastener;* Calvin Adams, Pittsburgh, Pa.

"My invention consists in attaching to, and combining with the latch or bolt of a shutter fastener, a contrivance for bowing the shutter; that is, securing it in its position when partially opened."

Claim.—"I do not claim the construction of the shutter fastener, nor the use of the latch and pin as used for fastening shutters when closed, nor otherwise than in combination with the contrivance for bowing shutters; but what I do claim is, the combining with the latch or bolt of an inside shutter fastener, a contrivance for securing the shutters in a partially opened position by means of the rings and the arm, in combination with th latch and pin, substantially in the manner and for the purpose set forth."

86. For an *Improvement in Self-Acting Bar Excavators;* G. T. Beauregard, N. Orleans, Louisiana.

Claim.—"What I claim is, the bar excavator, in which the surface current, by means of the inclined plane, is deflected downward, and made to act upon the bar, the whole being arranged and operated substantially as described."

87. For an *Improvement in Devices of a Convertible Dung Fork;* Ezra H. Dawes, Litchfield, Maine.

"The nature of my invention consists in attaching the tines of an ordinary dung fork to the handle by means of a joint, round which they are permitted to revolve in such a manner that they may be secured in one of two positions; the same instrument is thus made to serve a double purpose, and may be used either as an ordinary dung fork, or as a garden cultivator or prolonged hoe; or, having been made use of as an ordinary dung fork with which to load manure, it may be instantaneously shifted so as to serve the purpose of handling the manure from the cart into hills, or otherwise, as the case may require."

Claim.—"What I claim is, making the tines of ordinary dung or hay forks to revolve upon the handle, in the manner and for the purpose set forth."

88. For *Improvements in Propelling Vessels;* Frederic P. Dimpfel, Philadelphia, Pa.

Claim.—"What I claim is, the arrangement of the water passages, apertures, and valves, in combination with a reciprocating piston and its chamber, substantially in the manner and for the purposes set forth."

89. For an *Improvement in Lounges;* Augustus Eliaers, Boston, Massachusetts.

"My improvement in lounges, couches, or other articles of furniture in which it is desirable to vary the inclination of the back, consists in arranging the back or support to the upper part of the body upon springs, so that it can be inclined simply by the weight of the occupant at pleasure, the part which forms the support being attached to the body of the lounge by hinges, and being fastened in any desired position by a curved arm and set screw."

Claim.—"What I claim is, resting the part which forms the support to the upper part of the body in lounges, or other similar articles of furniture, upon springs and hinges, as above described, so as to vary its inclination at the pleasure of the occupant; the said support being fastened and held in any desired position, by a set screw and curved arm, as above set forth."

90. For an *Improvement in Library Step Chairs;* Augustus Eliaers, Boston, Mass.

Claim.—"What I claim is, a library step chair, or a chair which may be changed at pleasure into a flight of steps, in which the fold or hinge of the two parts is formed in the top, or an extension of the front leg of the chair, thereby permitting the seat to be so stuffed as to form an ornamental and comfortable chair, and when opened, to form a flight of five steps, as set forth."

91. For an *Improvement in Bee Hives;* Wooster A. Flanders, Sharon, Vermont.

Claim.—"It is evident that my invention may be carried out in a great variety of ways; I do not therefore confine myself to the peculiar construction above described; but what I claim is, the adjustable passage, by which the entrance to the hive may be enlarged or diminished, in manner and for the purpose substantially as set forth."

92. For an *Improvement in Attaching Horses to Ploughs;* John D. Filkins and Wm. H. De Puy, Lima, Indiana.

Claim.—"What we claim is, the combination of the limber and stiff tongues with the running gear, to adapt it to being drawn by two teams abreast, as described."

93. For an *Improvement in Cutting and Planting Potatoes;* Samuel Hutchinson, Rockport, Indiana.

Claim.—"What I claim is, the construction and combination, as herein described, of cam, sliding platform, cutting blade, and trap doors, with the furrowing share and covering blade, for the purpose of cutting, dropping, distancing, and covering potatoes."

94. For an *Improvement in Winnowers;* David S. Mackey and Jarvis R. Smith, Batavia, New York.

"The nature of our invention consists, 1st, In a peculiar manner of operating the screen, viz: by means of two eccentrics working between blocks attached to the underside of the

screen. 2d, In having two blasts proceed from a single fan, said blasts crossing each other, and being so arranged that the grain is subjected to one of the blasts before passing through the screen, while the other blast prevents the screen from being clogged with chaff and other matter."

Claim.—"What we claim is, 1st, The peculiar manner of opening the screen, viz: by means of the eccentrics placed in a reverse manner upon the shaft, said eccentrics working between the blocks attached to the underside of the screen, as shown and described. 2d, Producing two blasts from a single fan, as shown, and having the two blasts cross or intersect each other, by which a blast passes horizontally over the top of the screen, and a blast also passes upward through the screen, preventing the screen from being clogged or choked by the chaff."

95. For an *Improvement in Machines for Dressing Stone;* E. G. Matthews, Troy, New York.

Claim.—"What I claim is, 1st, The driving apparatus for driving the cutters, said apparatus being formed and constructed of the driving wheel and friction wheel, arranged substantially as herein specified, in the frame attached to the driving rod, by means of which rod a reciprocating motion is given to the said frame, which causes the driving wheel to roll back and forth, on and over the heads of the cutter stocks, thereby causing the cutters to make the desired cut in the stone, the friction wheel meanwhile rolling on the periphery of the driving wheel, and also in a groove in the cross bar, as before described. I do not intend to confine or limit myself in this claim, exclusively to the use of one friction wheel, but hold myself at liberty to use one or more, and to vary the arrangement of them, while the principle of driving the cutters as herein described and shown is substantially adhered to. 2d, I claim the rocking bar, with inclined planes at each end, in combination with the cutter stocks and the roller, or its mechanical equivalent, attached to the frame of the driving apparatus, for the purpose of rolling or striking on the inclined planes of the bar as the driving apparatus reaches the end of its stroke, so as to rock or tip the bar, thereby causing the inner edge of the bar to catch or stroke under the shoulders in the cutter stocks, and raise them up in position for the driving wheel to act upon them in its return stroke, substantially as herein specified."

96. For an *Improvement in Ships' Side Lights;* Charles Perley, City of New York.

"The nature of my invention consists in the use of a circular glass or light, enclosed by a frame, on which are cogs or teeth gearing into a fixed rack on the inside of a metal box that is let into the side of a vessel. To open the light it is rolled to one side within the box or case, and when it is to be closed the light is rolled back again, and a screw ring forced into an elastic packing in the frame of the glass, makes a tight joint, and any water that by accident may run into the box in which the light rolls, can escape by a small opening left in the lower part for the purpose, thereby entirely preventing any leakage from entering the ship."

Claim.—"I do not claim sliding a glass or light sideways in a frame, as that has been done; but I am not aware that any box has been so fitted as to contain a side light and form a receptacle for leakage, passing the same out by a small hole or holes, thereby effectually preventing any water from passing into the ship. I am aware that india rubber has been used as a packing for side lights; therefore I do not claim the same. What I do claim is, 1st, The means herein described and shown, for preventing any leakage from a side light passing into a vessel, by enclosing the side light in a metallic box let into the side of the vessel, and provided with a small hole or holes to pass out said leakage, as specified."

97. For an *Improved Valve Gauge for Bottles;* Alphonse Quantin, Philadelphia, Pa.

Claim.—"What I claim is, the above described machine or gauge, with the arrangement of the valves, as herein before described, one opening by the act of closing the other, so as to pour out of the vessel to which the gauge is attached, only the quantities of liquid contained in the space between the two valves."

98. For *Improvements in Metallic Piston Packing;* Henry L. Russell, Hudson, Mich.

"The invention consists in expanding a number of metallic bands by means of levers secured in the periphery of a drum, and operated by means of a ring fitted within said drum, and arranged as will be hereafter shown."

Claim.—"I do not claim the metallic bands, for they are now used in metallic packing; but what I do claim is, expanding the metallic bands which encompass the drum by means of the levers placed in the periphery of the drum, and operated by means of the ring within

the drum, as herein shown and described, the ring being prevented from moving casually, by means of the coil spring, and ratchet and pawl, or their equivalents."

99. For an *Improvement in Making Shovels, Spades, &c.;* William Richards, Philadelphia, Pennsylvania.

Claim.—"I claim the manufacture of shovels, spades, and other instruments made of a composite sheet of metal, whose constituents are parallel laminæ of unequal hardness, as herein set forth; but I make no claim to such implements made of the hard laminæ extending for a short distance only above the edge, but only where it extends up beneath the strap to support the back."

100. For an *Improvement in Expanding Horse Shoes;* Benjamin Perry Sargent, Sutton, New Hampshire.

"The nature of the principal part of my invention consists in making the quarters of the shoe separate from each other, and uniting them together, or to a toe bar, by means of one or two joints, and providing the quarters with one or more expanding screws, by which, when they are secured to the foot of the animal, they may be expanded or moved apart from each other."

Claim.—"What I claim is, the combination of the bearers or ears with the jointed quarters or bars, jointed together, or to a common toe piece or cork, and operated by an expansion screw or contrivance, as specified."

101. For an *Improvement in Garden and other Hoes;* Jacob T. Sargent, Sutton, New Hampshire.

Claim.—"I do not claim the employment of a screw and nut for confining two things together; nor do I claim the attachment of the shank and blade of a hoe by means of the bearing plates welded to and forming part of the shank, and riveted to the blade; but what I do claim is, my improved attachment of the blade and shank, whereby the blade not only can be readily removed from, or as readily confined to the shank, but when affixed to it is prevented from breakage where the greatest leverage or strain is brought upon it; meaning to claim the bearing head fixed firmly to, and making part of the shank, the movable plate or stiffener, or its equivalents, (applied to the back of the blade, and made separate from the shank,) the screw on the shank, the screw nut, and the recess in the hoe blade, as combined together and with the shank of the handle, and made to operate substantially as specified."

102. For an *Improvement in Spring Clamps for Clothes Lines;* David M. Smith, Springfield, Vermont.

Claim.—"I do not claim a mere clasp composed of two levers hinged together between their respective ends, and having a spring placed between their two adjacent arms; but what I claim is, the above described improved clothes pin; that is to say, I claim the arrangement of the line opening and the spring on opposite sides of the hinge of the two levers, all substantially as herein before specified, whereby, by pressure of the longer legs of the levers between the thumb and fingers of the hand of a person, the instrument is rendered very convenient of application, without danger during the same of tearing the clothes secured by it on a line."

103. For *Improvements in Propellers;* James Trees, Salem, Pennsylvania.

Claim.—"What I claim is, the combination with submerged propellers, whose area, where the water enters, is greater than the hinder extremity where the water escapes, of helical blades or vanes, and a tapering shaft, to which they are attached, both the blades and shafts tapering from point to rear, substantially in the manner and for the purpose set forth."

104. For an *Improvement in Ox Yokes;* Albert Vose, Pittsfield, Vermont; ante-dated August 10, 1853.

Claim.—"What I claim is, 1st, The construction of the semi-revolving neck blocks, each having a curved groove and pin fitting into it, for enabling the neck block to always adjust itself at right angles to the direction of the neck of the animal. 2d, I claim, in combination with the groove in the neck block, the use of the pin, subserving the double purpose of controlling the movement of the neck block, and adjusting the length of the yoke, substantially as described."

105. For *Improvements in Cutting Bars and Teeth of Curry Combs;* Wm. Wheeler, West Poultney, Vermont, Assignor to Charles H. Kellog, Troy, New York.

Claim.—"What I claim is, the method of forming the bars of curry combs by punching them out of plates, so that at a single operation, a strip of the proper width for the bar is severed from the plate, and one row of teeth cut thereon, and another row upon the end of the plate for the next bar, substantially as set forth."

106. For an *Improvement in Soda Fountains;* Wm. Coughlan, Baltimore, Maryland.

"The nature of my invention consists in adding an auxiliary faucet or valve, whereby I am enabled to quickly fill the fount with mineral water already prepared in convenient stationary apparatus."

Claim.—"What I claim is, the auxiliary or valve, for the purpose of enabling the fount to be filled with prepared mineral water, substantially as described."

107. For an *Improvement in Attaching the Head Cringle to the Yards of Vessels;* Nelson Crocker, Sandwich, Massachusetts.

Claim.—"What I claim is, the head cringle hooks and their fixtures, constructed and combined with rigging of a vessel, substantially in the manner and for the purpose set forth."

108. For an *Improvement in Seed Planters;* Nathan C. Davis, West Jefferson, Ohio.

Claim.—"What I claim is, the piston provided with a notch or hollow in its upper end, and so arranged in combination with the partition and depression, that it will bring up and discharge through the aperture the desired number of grains of corn every time it is raised by the operator, substantially in the manner set forth."

109. For an *Improvement in Machine Hammers;* Daniel Noyes, Abington, Mass.

"The essential features of my improvements consist in a novel arrangement of mechanical devices for hammering or forging iron, whereby it can be brought into any desired shape or form much more expeditiously and with much greater regularity than by any of the modes commonly practised in trip hammers for the purpose. This result I effect by means of hammers, which are so placed and actuated as to strike the iron to be shaped both on the top and on the two sides, the upper hammer having motion imparted to it from a crank on the main driving shaft, and the two side hammers moving horizontally, so as to strike the sides of the piece to be forged."

Claim.—"What I claim is, 1st, A machine for hammering iron, &c., having the distinguishing features herein above enumerated, viz: a hammer for giving the blow upon the upper surface of the iron, acting in conjunction with two hammers which simultaneously strike the sides of the iron, substantially as above set forth; and I further claim, in a machine for hammering iron, the use of these two side hammers operating as specified, whether used in connexion with the upper hammer, or without it. 2d, I claim so arranging the relative position of the fulcra of the hammer beams, and the ends of the connecting rods attached to said beams, and to the crank shaft and gears from which they derive their motion, as to bring the said fulcra and connecting rods in nearly a straight line at the time of giving the blow for the purpose above specified, the opposite ends of the connecting rods, just before giving the blow, moving in opposite directions, so as to give a rapid and powerful blow. 3d, I claim causing the anvil to descend from the iron just before the blow of the side hammers, and to ascend just before the blow of the upper hammer, by means of a rod attached at one end to the under side of the upper hammer beam, and at the other end to a tilting arm, which embraces the anvil, substantially as above described."

110. For *Improvements in Screw Nails;* Samuel Pratt, Boston, Massachusetts.

Claim.—"What I claim is, a screw nail constructed with a thread, shaped substantially as described. I also claim shaping the head substantially as set forth, so that the battering caused by the driving will not obstruct the application of the turn screw."

111. For an *Improved Spark Arrester;* Samuel Sweet, City of New York.

Claim.—"I desire it to be understood that I make no claim to originality of invention in the individual parts of the spark arrester, separately considered; but what I do claim is, the combination of the reticulated inverted frustrums of cones, constructed and situated as described, with the trumpet-shaped deflector and guard, the reticulated cylinder under the opening provided with the reticulated valve, when these parts are arranged in the upper

portion of an enlarged or expanded external pipe, such as that represented, the whole operating in the manner and for the purpose set forth."

112. For an *Improvement in Looms for making Weavers' Harness;* Kasimer Vogel, Chelsea, Mass.

Claim.—"I wish it to be understood that I do not confine myself to the precise details herein before set forth; but what I claim is, the combination of the loom for weaving the borders of the harness, with the press for securing the metallic eye upon the threads of the harness without a knot braid or loop, substantially in the manner described."

RE-ISSUE FOR OCTOBER, 1853.

1. For an *Improvement in Spark and Gas Consumers;* David Matthew, Philadelphia, Pennsylvania, October 4.

Claim.—"What I claim is, the manner in which I have constructed and arranged the respective parts that constitute the inner and outer cases of the apparatus, which is placed at the top of the chimney. Also, I claim the manner of constructing and arranging the trumpet-mouthed tube within the inner case, said tube being divided into two or more parts, and being made to deposite and discharge the larger portion of the sparks by the aid of the opening between said parts, as described, substantially as set forth. I also claim the manner in which I connect the apparatus at the top of the chimney with the furnace or fire box, by means of the tubes or pipes, the cases, and the openings thence into the fire box or furnace, for the purpose made known. I likewise claim the manner of preventing the entrance of water into the fire chamber by the employment of the tubes, in combination with the tubes."

DESIGNS FOR OCTOBER, 1853.

1. For a *Bedstead;* John H. Barth, Indianapolis, October 4.

Claim.—"What I claim is, the design, configuration, and arrangement of the several ornaments and mouldings on the posts, rails, head, foot, and side boards and cornice, as fully set forth."

2. For a *Cooking Stove;* Julius Holzer, Assignor to North, Chase & North, Philadelphia, Pennsylvania, October 4.

Claim.—"What I claim is, the use of the ornaments and null mouldings described."

3. For *Stoves;* George H. Fryday, County of Philadelphia, Assignor to North, Chase & North, Philadelphia, Pennsylvania, October 4.

Claim.—"What I claim is, the design and configuration of the ornamental screen and standards, and the combination of the same with the ornamental base and the cylinder, as described."

4. For *Stoves;* Garrettson Smith & Henry Brown, County of Philadelphia, Assignors to North, Chase & North, Philadelphia, Pennsylvania, October 4.

Claim.—"What we claim is, the design and configuration of the mouldings and ornamental work, as described."

5. For *Cooking Stoves;* Hosea H. Huntley, Assignor to Daniel F. Goodhue, Cincinnati, Ohio, October 4.

Claim.—"What I claim is, the combination and arrangement of the ornamental forms and configurations of a cooking stove."

6. For *Stoves;* Garrettson Smith and Henry Brown, Assignors to C. W. Warnick & F. Liebrandt, Philadelphia, Pennsylvania, October 4.

Claim.—"What we claim is, the design, configuration, and arrangement of the ornaments in bas relief and mouldings set forth."

7. For *Metallic Coffins;* Theodore J. Gillies, Willliamsburgh, New York, October 11.

Claim.—"What I claim is, the design of the shape and configuration of the coffin, as described."

8. For *Cooking Stoves;* N. Putnam Richardson, Portland, Maine, October 25.

Claim.—"What I claim is, the general ornamental design of the stove, as shown in the side and front plates, including the legs, and as represented in the accompanying drawings; and separately I claim the ornamental design of the oven door, that of each of the front doors, that of the front, that of the door, that of the panel."

9. For a *Register;* Joseph A. Read, Assignor to William W. and Charles M. Atkins, Philadelphia, Pennsylvania, October 25.

Claim.—"What I claim is, the design, configuration, and arrangement of the ornaments in bas relief on the slide and plate, as set forth."

NOVEMBER 1.

1. For *Improved Protecting Bulwarks for War Vessels;* William Ballard, City of New York.

Claim.—"What I claim is, the use of the shield board, in combination with the bulwarks of a ship, substantially as set forth. Also, the use of the stanchions and panels, in combination with the deck of the vessel and the shield board, for the purposes and principle of construction and operation, substantially as set forth."

2. For an *Improvement in Magneto-Electric Machines;* Calvin Carpenter, Jr., Pawtucket, Massachusetts; patented in France, April 18, 1853.

Claim.—"I do not claim the employment of permanent magnets of helical coils of wire of metallic segments, upon a cylinder of non-conducting material, or of springs such as I have described, either separately or in combination, for the purposes set forth, otherwise than in the manner in which I have arranged, connected, and combined them; but what I claim is, the combination of one or more series of permanent magnets, radially arranged; the poles of each series being in one plane, and in two concentric circles, with a disk or disks of helices arranged in three sets, in such manner that the three sets may be acted upon successively, at nearly equal intervals of time; one set by the inner circle of poles, and the other two sets by the outer circle of poles; the currents of the several sets of helices being thrown into one constant or uninterrupted current by means of the current dischargers and springs, or their equivalents, as herein described."

3. For an *Improvement in Car Couplings;* A. P. Chatham, Canoga, New York.

Claim.—"What I claim is, constructing the buffer with a recess to hold the link in the proper position for entering the buffer, and the buffer with a cavity and uninclined draft catch, extending to nearly the top of its cavity, so that when a link is connected to the buffer, and pressed over the catch of the buffer, it cannot jump up and become detached from the catch while the cars are in motion; whereby the danger of the cars being separated while running, is greatly lessened, while the coupling is simple, cheap, and not liable to get out of order."

4. For an *Improved Pen and Pencil Case;* Gilbert S. Clark, City of New York.

"The nature of my invention consists in a peculiar arrangement of the pen and pencil slides, whereby I obtain an extension case for both pen and pencil, and am enabled to shove from the case either the pen or pencil, as occasion may require."

Claim.—"I claim neither the pen or pencil slide separately, for both have been previously used; but what I do claim is, the peculiar arrangement of the pen and pencil slides, as herein shown and described, viz: having the pencil slide with its covering tube placed within the pen slide or the tubes, and operating the two slides independently of each other, in the manner as set forth."

5. For an *Improvement in Cane and Maize Cutters;* John W. Cormack, Quincy, Ill.

Claim.—"What I claim is, the framing, and manner of attaching the knife and arm to the sled."

6. For *Improvements in Condensers for Steam Engines;* Benjamin Crawford, Pittsburgh, Pennsylvania.

Claim.—"What I claim is, the arrangement of the tubes or passages in the condenser with the inlet and outlet openings in the case, substantially as specified, so that a current of cold water is caused to flow round both ends of the tubes, whereby the condenser is prevented from undue heating, and the tubes kept coolest at both ends, and warmest at the middle, whereby the great bulk of the heat is transferred to the condensing water near

the point at which it is discharged from the case. 2d, Constructing the case of the condenser with stuffed, or other equivalent joints, to render it flexible, and thereby prevent fracture."

7. For *Improvements in Machines for Sticking Pins;* Chauncey O. Crosby, New Haven, Connecticut.

Claim.—"I am aware that conical rollers have been used for forming the inclined channel for conducting the pins, and that a screw has been used to separate the pins, and that players have been used in the manufacture of pins, and that clamping bars have been used for clamping the paper after it has been crimped, and that the paper has been drawn through and rolled up by a revolving cylinder, so graduated as to regulate the quantity of paper as to folding up; I therefore do not claim either of these as such, as my invention. But what I claim is, the method of crimping the paper by means of movable folding blades, in combination with the bed plate, while the back and front sides of the paper are sustained by the damping bars, substantially as herein described. 2d, I also claim the method of crimping the paper by means of moving folding blades, descending and ascending between the stationary and moving clamping bars, when the clamping bars serve as a part of the crimping apparatus, whether the paper be sustained by a bed plate or otherwise, when constructed and operating substantially as herein described. 3d, I also claim the method of lifting the pins from the distributor, and carrying them away and sticking them into the crimped paper, while the distributor is bringing another supply of pins in front of the clamping bars; thereby keeping the lifting players or other lifting apparatus continually in operation, when performed by the means and in the manner substantially as herein described. 4th, I also claim the lifting apparatus, or any substantial part thereof, when constructed, combined, and made to operate substantially as herein described. 5th, I also claim the combination of the lifting apparatus herein described, with the inclined transverse notches in the stationary clamping bar, by which means the pins will always stick in an exact line, even though the pins are not straight, when constructed, combined, and made to operate substantially as herein described. 6th, I also claim the combination of the conical rollers with the side planes, to form a straight, inclined, conducting channel, when combined, constructed, and made to operate, substantially as herein described. 7th, I also claim the lifting players, when constructed and made to operate substantially as herein described, either with or without the creeper, sliding guide, or director."

8. For *Improvements in Machines for Sticking Pins;* Chauncey O. Crosby, New Haven, Connecticut.

"My improvement consists in the use of twenty (or any other number,) of straight, inclined, conducting channels, to arrange and conduct the pins, with a slotted plate, or slide, to receive them at the lower end of the channels, and convey them to an equal number of spaces in an inclined or triangular block, through which they fall into horizontal grooves, and by an equal number of punches sliding in those grooves, to force the pins into the crimped paper."

Claim.—"I do not claim the channels nor grooves, nor the punches working in the grooves, nor the use of clamping bars to serve also as crimping bars, because these have all been used before, or claimed in my former application; but what I do claim is, the combination of the punches, (working in horizontal grooves,) with the slide, and the straight, inclined channels, when arranged and combined substantially as herein set forth. I also claim the combination of the punches with the double folding blades, when these are combined with the movable and stationary clamping bars, and the whole is constructed and combined substantially as herein described. I also claim the method of crimping the paper by means of folding blades, working between stationary and moving clamping bars, when those clamping bars serve as a part of the crimping apparatus, when constructed and operating substantially as herein described. I also claim the bars, (forming the side guides to the spaces,) to guide the pins while falling down from the separator to the horizontal grooves, in combination with the grooves and punches, when they are constructed, combined, and arranged, and used for the purposes substantially as herein described."

9. For *Improvements in Machines for Sticking Pins;* Chauncey O. Crosby, New Haven, Connecticut.

Claim.—"What I claim is, the use of a split wheel to connect the lower end of the straight, inclined, conducting channel, with the upper end of the vertical side guides, to convey the pins from the former to the latter, while it changes the position of the pins

from vertical to horizontal, as herein described, whether with or without the counter sinks in the inner edges of the peripheries. I also claim the use of a separating wheel, with teeth on its periphery, to sustain the column of pins, separate them, and drop them separately into the grooves in the sliding bed at the proper time, by its revolution, as herein described, whether the wheel be made of the two disks, or with the periphery grooved out, or the periphery be single, and the teeth cut directly across it. I also claim the method of crimping the paper by the use of jaws, with a tongue between them, to slide across the paper in such a manner that the paper may be crimped by double folding blades, forcing the two folds of the paper through the space between the tongue and the jaw on each side, so that the pins may be stuck through the crimps over the upper edges of the folding blades, while the tongue will be between the pins and the paper, and so that both the bars and tongue, and the double folding blades may be readily withdrawn, to release the paper: and this, whether the double folding blades are below or above the jaws and tongue, when they are constructed and used, and made to operate, substantially as herein described."

10. For a *Hose Protector;* David Demarest, City of New York.

Claim.—"What I claim is, the employment of a portable section of a rail track, constructed substantially as described, and with an opening in its centre for the hose to fit in, when said section is placed over said hose, the same being employed in the manner described, and for the purpose of covering the hose at certain points, and saving them from the great injury they sustain from carriages and cars passing over them during the time of fires, &c., as set forth."

11. For an *Improvement in Car Wheels;* Joseph Farnsworth, Jr., Madison, Indiana.

Claim.—"I am aware that P. W. Gates made a cast iron car wheel, in which the rim is connected to the central parts by two sets of short spokes; but this (without admitting its priority to my invention) I do not claim, as my improvement relates exclusively to the class of wheels in which a disk extends from the hub to the rim; my object being to support the rim and strengthen the disk by flexible supports, which will perform their duty without straining and endangering the breaking of the disk, as in the case of the wheels of this class before mentioned. Therefore, what I claim is, a cast iron car wheel, constructed as herein described; but I make no claim to any part of the wheel by itself, nor to any other combination of parts than that above set forth."

12. For *Improvements in Regulating the Speed of Steam Engines;* Luther R. Faught, Macon, Georgia.

"The nature of my invention consists in causing the cut-off to move with the valve by means of friction produced between them by suitable means, and attaching the former to a pendulum or other device, which is capable of offering to its movement a resistance which causes it to move a shorter distance than the valve, and thus close the steam openings of the valve, and cut off the steam before the termination of the stroke of the engine, and which increases or diminishes with the increase or diminution of speed of the engine, so as to close the passages and cut off the steam earlier or later, as may be required, and thus regulate the speed of the engine."

Claim.—"I do not confine myself to the employment of a pendulum or air spring, as there may be other devices that would produce analogous effects; neither do I confine myself to the precise methods of producing friction, herein described, as both the methods that I have shown are well known, viz: by the pressure of the steam in the valve chest, and by plates compressed to the rod by a spring; nor do I confine myself to the adjustment of the relation between the pendulum and the device or devices which produce the friction, as it will be evident that the lengthening or shortening of the pendulum will produce the same effect; but what I do claim is, connecting the cut-off with the slide valve, so that the latter drives the former by friction, when the cut-off is at the same time connected with a pendulum air spring, or some other device, offering such a resistance to its movement as will prevent its moving the same distance as the valve, and arrest it at such a point in the motion of the valve as to cut off the steam at the desired point in the stroke, and will increase or diminish with any increase or diminution of the speed of the engine, and thereby retard the motion of the cut-off more or less, in order to cut off the steam earlier or later in the stroke, and thus regulate the speed, substantially as described."

13. For an *Improvement in Grain Cradles;* Christopher P. Kelsey, Livingstonville, New York.

"My invention consists in so constructing the cradle, that not only shall the workman

be enabled to lay the grain more regularly, to cut the entire length of the scythe, and to readily adjust the set, or 'bover,' of the fingers, as compared with the snath and scythe; but also, that the implement shall balance better in the hands, and shall be capable of being folded closely together, when not in use, whereby it may be more easily transported, or stowed away, as the case may be."

Claim.—"What I claim is, 1st, The bar, or its equivalent, for attaching the frame of fingers to the snath, for the purposes set forth. 2d, So connecting the braces with the fingers, by means of link or other universal joints, that the snath may be folded close against the fingers, without requiring that the said braces shall be loosened in the snath; the whole being constructed and operating substantially in the manner set forth."

14. For an *Improvement in Coating Sheets of Metal;* Edmund Morewood and George Rogers, London, England.

"Our improved apparatus consists of a metallic vessel, having a flanch round its top, to give it the requisite strength; this vessel should be made of wrought iron, and of a length somewhat greater than the longest sheets to be coated, and of such a depth, that these sheets can be immersed in the bath of melted metal, at least eight or ten inches, when standing on edge."

Claim.—"What we claim is, the method herein described, of coating sheets of metal, by immersing them in other molten metals, which are more fusible, by means of rollers, arranged substantially as herein described; so that with the same machine, sheets of metal, varying in thickness, may be coated, free from puckers, bends, or indentations, on their surfaces,—thus rendering unnecessary, the subsequent operation of flattening, which heretofore could not be dispensed with."

15. For an *Improvement in Adjustable Springs for Carriages;* Russell S. Morse, Dixfield, Maine.

Claim.—"What I claim is, the adjustable auxiliary springs, in combination with the bed spring (or springs), substantially in the manner and for the purpose herein set forth."

16. For *Carpenters' Brace and Bit Fastener;* Howard Perkins, North Bridgewater, Massachusetts.

Claim.—"What I claim is, the manner of constructing and fastening the bit into the socket by the slide-lock, as described, having the end of the bit so formed, as to fit into the groove in the key, as set forth, and having the end of the bit press down upon the key, so that when the key is slipped back, the bit may be easily removed."

17. For an *Improved Gold Washer;* Henry M. Ritterband, City of New York.

Claim.—"What I claim is, the combination of the tube, valve, and lip, constructed and having the relative proportions substantially as described, forming an apparatus for removing earth and stones from auriferous earth, as specified."

18. For an *Improvement in Straw and Grain Separators;* John A. Taplin, Fishkill, New York.

Claim.—"What I claim is, the vibrating straw carrier and grain separator, as herein set forth, with a screen and fluted bottom board, for the purpose of separating the grain from the straw—returning the former to the winnowing apparatus, and conveying the straw to the hinder extremity of the machine."

19. For an *Improvement in Metallic Pens;* William H. Towers, Philadelphia, Pa.

Claim.—"What I claim is, making metallic pens, with depressions or cavities for retaining the requisite quantity of ink to supply the same, and making them flat on both surfaces, and tapering the shank or main body of the same, and inserting it in a corresponding socket or opening in the centre of the lower end of the pen holder, substantially in the manner and for the purpose set forth."

20. For an *Improved Machine for Turning Cylinders of Wood;* Increase S. Waite, Hubbardston, Massachusetts.

Claim.—"What I claim is, the combination, composed of the feeding hopper, the series of rotary mandrels and centres, applied to the shaft; the revolving cutter or cutter cylinder, the mechanism for giving to each mandrel an endwise movement, backwards and forwards, as described; mechanism for arresting the rotary movement of the shaft, or the heads, during the time necessary for the operation of the cutter or cutter wheel, on each piece of wood; and, finally, a mechanism for rotating the shaft and its two heads, all sub-

stantially as above described; the mechanism for moving each mandrel endwise, in manner and for the purpose described, being the spring, the wheel, and cam-plate, as described; that for rotating the mandrel, being the gear, and the gear on the shaft, put in revolution as described; that for arresting the rotation of the shaft, during the time necessary to turn down an article, being the stud, stop-plate, and the screw applied to each mandrel, and made to operate as specified; and, finally, that for rotating the shaft, being the friction roller, made to operate against the periphery of the circular head, and to be rotated and borne against said head, as set forth."

21. For *Improvements in Generating and Condensing Steam;* Peter H. Watson, Washington, District of Columbia; ante-dated May 2, 1853.

Claim.—"What I claim is, the method of recovering the heat of the exhaust steam by passing it through the comparatively cool water in the lower portion of the boiler, substantially as set forth. I also claim the arrangement of the upper end of the drop flues in an inclined plate, to facilitate the entrance of the smoke into the flues, and the passage of the steam from beneath the inclined plate into the upper part of the boiler, substantially as set forth."

22. For an *Improvement in Grain Separators;* Jacob V. A. Wemple, Chicago, Ill.

Claim.—"What I claim is, the employment of a cylinder, having tangential or other suitably projecting plates across or along its periphery, for the purpose of separating the grain, and breaking the impinging effect produced by the threshing cylinder on the endless apron, the said cylinder being so situated and operating in rear of the threshing cylinder, as gently to feed over it the straw and headings as they are delivered from the threshing cylinder."

23. For an *Improvement in Bee Hives;* Geo. Calvert, Upperville, Virginia.

Claim.—"What I claim is, the combination of the honey boxes with the box and cross pieces, arranged and operated in the manner and for the purposes set forth."

24. For an *Improvement in Devices for Steering Cultivators;* Seneca Lapham, Salem, Ohio.

Claim.—"What I claim is, the combination and arrangement of the parts, consisting of the lever and its attachment to the brace, and the connexion of the tongue to the lever by the staple; this I claim in its application to the purpose of changing the direction of this and other machines, as specified."

25. For an *Improvement in Fluid Metres;* Wm. B. Leonard, City of New York.

Claim.—"What I claim is, the combination in fluid metres, of mechanism for measuring the volume of a flowing fluid, however variable; mechanism for measuring the velocity of the flowing fluid, however that may vary; mechanism for multiplying these two quantities together; and mechanism for recording the product in such manner as to show on a register the quantity of fluid that has passed, as set forth. I also claim the combination of a self-acting guard valve or valves, however constructed or arranged, with the water wheel or other motor, in a metre, in such manner that the flow of water through the metre will be arrested, whenever its pressure is not sufficient to give motion to the motor the instant it begins to flow, whereby the escape of water through the metre, unmeasured, is prevented."

26. For an *Improved Mode of Opening and Closing Gates;* Wm. T. Merritt, Hart's Village, New York.

Claim.—"What I claim is, the method of elevating or depressing, or opening and closing the gate, as herein shown and described, viz: by means of the shaft having upon it the pulleys, the pulleys being attached permanently to said shaft, and having ropes attached to them; and the pulleys being placed loosely on the shaft, and connected to it at a certain period by means of pins on the shaft, working in slots in the bosses or hubs of the pulleys; the said pulleys having the chains attached to them and to the upper ends of the gate styles; and also the chains with the weights, the said chains being attached to the lower ends of the styles; the gate being prevented from being casually depressed, by means of the pawl, which is freed from the notch in the boss or hub by the dog, substantially as set forth."

27. For an *Improvement in Machines for Straightening and Curving Rails;* George Williston, Brunswick, Maine.

"The nature of my invention consists in placing over the part of the rail which is bent,

(by the weight of the train in passing,) a curved beam, which has its bearings on the rail near the end of the beam; then, by a contrivance which embraces the rail, I turn a screw, which has power sufficient to raise the bent portion to its original position, where it may be secured."

Claim.—"I am aware that a machine has been used in Bavaria, which acts by the pressure of a screw upon the bar to be bent; the bearing or platform being placed underneath the bar; this mode of action I do not claim; but what I do claim is, the combination of the screw, strap, beam, and slides, constructed and combined substantially in the manner described, with the beam placed on the top or side of the rail, for the purpose of straightening or curving rails on railroads, without the necessity of removing the same from the sleepers."

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28. For an *Improvement in the Cutting Gear of Grain and Grass Harvesters;* Sam'l. S. Allen, Salem, New Jersey.

Claim.—"What I claim is, the arrangement by which the driving wheel is made the centre of oscillation in counterbalancing the cutter beam and cutters thereon, embracing the secondary wheel and spring, for the purpose set forth. I also claim the combination of the tongue with the driving wheel and secondary wheel, for the purposes set forth. I also claim the method of balancing the cutter blades on the angular bar by the sliding bar, in combination with the blade, or their equivalents, for the purpose set forth. Lastly, I claim the construction of the cutter blades, as formed on the under side with a rasp or roughened surface, while the upper side forms a shear cutting edge, for the purpose of preventing choking of the fingers, and supplying an oil box to the cutter bar, as set forth."

29. For an *Improvement in Carriers to Grain Separators;* John Blue, Covert, N. Y.

Claim.—"I claim the arrangement of the cam blocks, or their equivalents, on the shaft, for agitating the endless apron, as set forth."

30. For an *Improvement in Violins, &c.;* Cornelius S. Cooper, City of New York.

"The nature of my invention consists in removing and taking from any of said above mentioned instruments, the original beam or bass bar, which is firmly glued into the top or sound board the full length of said bass beam or bar, and putting in another beam or bar on an improved principle, which gives greater power and more brilliancy of tone to that noble instrument; the form of my improved plan for the beam or bass bar is shown in the accompanying drawings."

Claim.—"What I claim is, the application of the spring bass beam or bar, in place of the solid beam which is taken from the violin, for the violin, tenore or viola, violoncello, double bass or violono, or any other instrument requiring a bass beam or bar for the production of tone; then the support of the ends of said spring or improved bass bar, by cutting of notches or mortices in said end blocks, as shown in the accompanying drawings, and supporting said ends of spring in any manner, by connecting them or the bearings of said spring to said end blocks to produce the desired effect; also, the separation of the bass bar or beam from the top or sound board, except the three inches as before mentioned, using any wood which will produce the desired effect."

31. For a *Machine for Turning or Cutting Irregular Forms;* Nathaniel Gear, Zanesville, Ohio.

"The nature of my invention consists in making the cutter heads, one or both guides or gauges for the setting of cutting edges of the knives therein, and also guides or gauges to the pattern of the thing to be cut. Also, in the peculiar manner of securing the cutters into the cutter heads by dovetails, thus avoiding the use of keys, wedges, screws, or any other device than the shape of the ends of the knives, and grooves into which they fit."

Claim.—"What I claim is, the combination of knives, in the manner described, with a rotary cutter head, so that said head shall serve as a guide or directrix to the form or pattern carrying the material to be dressed."

32. For *Improvements in Power Looms;* James Greenhalgh, Jr., Waterford, Mass.

Claim.—"What I claim is, 1st, Suspending each leaf of harness from two jacks, which are of similar form and length, and are geared together by toothed sectors, substantially as described, for the purpose of preserving an uniformity of motion to both ends of the harness. 2d, Attaching the knife to the levers, and applying springs to the same, in

such a way that it will move on the levers in its descent in closing the shed, sufficiently to pass the points of those hooks of the ascending portion of the harness which are in a position to be raised to make the succeeding shed; and, after passing the points of the hooks, will slip under them, substantially as described. 3d, Suspending the heddle frames or the top rails, by means of sheet or hoop iron links, which are pivoted to the jacks, and are furnished with pins to enter slots or notches in the ends of the top rails, substantially as set forth, by which a simple means of attachment and detachment is obtained."

33. For an *Improvement in Temples for Looms;* Jerome B. Greene, Worcester, Mass.

Claim.—"What I claim is, the arrangement, substantially as described, of the roller, adjustable guard, and spring, upon the axle, which is parallel with the weft, whether the said roller and guard hold the cloth between two conical faces, or by teeth on the roller."

34. For an *Improvement in the Cutting Gear of Straw Cutters;* John Jones and Alexander Lyle, Rochester, New York.

Claim.—"We do not claim the knives, heads, or flanches which form a part of the heads, separately; but what we do claim is, the combination of the knives and segments of flanches, (which are attached to and form a part of the heads,) the knives being placed on the inside of the flanches, instead of the outside, in the manner and for the purpose substantially as set forth."

35. For an *Improvement in Fastening the Teeth to Clover Hulling Cylinders;* Sam'l. Karns, Bloody Run, Pennsylvania.

Claim.—"What I claim is, the binding of the teeth to the hulling cylinder by means of the wire band, as set forth."

36. For an *Improvement in Looms;* Jonathan Knowles, Cohoes, New York.

Claim.—"What I claim is, the combination of inclined guides with the whip roll, for the purpose of graduating the tension of the warps, substantially as set forth."

37. For an *Improvement in Screens of Winnowers;* Abraham Lash and Miles Moore, Belleville, Ohio.

Claim.—"We do not claim any form of any mill or shoe; but what we do claim is, the two fluted cleansers, or their equivalents, and the combination of said cleansers, as fully set forth and described; the same may be used in any common winnowing machine."

38. For an *Improved Wire Fence;* Wm. H. Meriwether, County of Comal, Texas.

Claim.—"What I claim is, the employment of the undulating or zigzag wire for fencing, substantially as described, which, by its elasticity, increases the durability and effectiveness of the fence, as specified."

39. For an *Improvement in Grain Threshers and Separators;* Abram B. Peterson, Dexter, Michigan.

Claim.—"What I claim is, 1st, The riddle, with swinging sections, as described, in combination with the interior carrier or elevator, to separate the grain from the straw, and discharge the grain on to the riddles under the head of the carriers or elevator, with the effect of permitting the cylinder and concave to be set low down, the whole operating substantially as set forth. 2d, The running of the riddle and carrier or elevator on separate and independent pulleys, in the manner and for the purposes described. 3d, The introduction of the protecting apron between the carrier or elevator and riddle, to serve the double purpose of preventing the straw from driving through the riddle, and protecting the carrier or elevator from abrasion by the grain, as fully set forth. 4th, Hanging the riddles or the riddle and wheat board to upright standards, as described, to give the upper riddle the longest stroke."

40. For a *Keyed Finger Board for Violins;* Wm. Robertson, City of New York.

Claim.—"What I claim is, combining with the finger board of a violin or musical instrument, or like musical instrument, a supplemental keyed finger board, constructed and operating substantially as described."

41. For an *Improvement in Attaching the Shafts of Vehicles to the Axles;* Safford E. Sturtevant, Hartford, Vermont.

"The nature of my invention consists in securing the shafts of vehicles to axles by means of an eye or collar, having taper or conical ends, which fit in adjustable sockets. The eye or collar may be attached to the shaft, and the sockets to the clasps which en-

compass the axle, or the eye or collar may be attached to the clasps, and the sockets to the shafts. The ends of the eye or collar are secured firmly in the sockets by means of a bolt which passes longitudinally through the eye or collar, and also passes through the sockets. By means of a nut on the bolt, the sockets may be brought nearer together, and made to fit tightly against the ends of the eye or collar, in case of the wearing of the same.

Claim.—"What I claim is, securing the shafts of vehicles to axles by means of an eye or collar having taper or conical ends which fit in adjustable sockets; the ends of the collar being kept firmly in the sockets by means of the screw bolt; the collar and sockets being attached to the shaft and axle in either of the modes herein described."

42. For *Improvements in Operating Vibrating Propellers;* Thomas Spiller and Anthony Crowhurst, Middlesex County, England; patented in England, Feb. 3, 1853.

Claim.—"Now, we wish it to be clearly understood that we do not confine ourselves to the shape of the vanes, blades, or fins, nor to the number applied, as there may be two or more sets used, or to the part of the vessel where the same may be applied, as at the stern, in the midship, or elsewhere below the water line; neither do we confine ourselves to the arrangement, as described, for giving motion to the propeller, or for regulating or reversing the action of the same; but what we claim is, vanes, blades, or fins, of whatsoever form or wheresoever applied in a vessel for the purpose of propelling the same, when such vanes, blades, or fins, are mounted on an axle or shaft, vibrating or turning freely upon its axis, and moving vertically through the water."

43. For an *Improvement in Railroad Car Ventilator;* Geo. Spencer, Utica, N. York.

Claim.—"I do not claim the use of a 'throat' and gathering, separately, nor of a surface of water separately, nor of an enlarged air chamber, or a series of them, separately, nor the combination of any two of them; but what I claim is, the application of a single 'throat,' being the termination of a 'gathering,' or gradually contracted opening, in combination and immediate connexion with a single enlarged air chamber directly above a surface of water, for the purpose of freeing the air forced into the car, from dust and cinders, thus enabling the dust and cinders to fall upon the water by their own gravity alone, substantially as described."

44. For a *Revolving Musical Scale;* Samuel D. Tillman, Seneca Falls, New York.

Claim.—"What I claim is, the employment of a fixed disk on which the musical intervals within the octave are represented by divisions of a circle, and the letters commonly used to designate the notes of the fixed scale, in combination with one or more arms, disks, or rings, rotating around the centre of the circle of the fixed disk, on which rotating arms, disks, or rings are the true and tempered divisions of the diatonic scale, so arranged that the relations of these divisions of the diatonic scale with those on the fixed scale, may be clearly seen, when the point designating the tonic or key note on the moving scale is placed opposite any of the divisions of the fixed scale, substantially in the manner and for the purposes set forth."

45. For an *Improvement in Wagon Brakes;* Wm. D. Williams, Raleigh, N. C.

Claim.—"I do not claim a double crank, attached to the front hounds of the wagon, and connected to the brakes behind the wheels, for applying the power through the action of the horse, forward and backward; but what I do claim is, forming two swinging or rolling joints between the front axle and the front hounds, in combination with the swinging brake, arranged on top the reach and in front of the wheels, for the purpose of rendering the wagon more perfectly self-locking, or for applying the brakes simply by the aid of the horse and wagon, and disengaging them by the forward action of the former; the whole being constructed, and arranged, and operating in the manner shown and described. I also claim making the brake capable of swinging on a centre, so that it may be thrown over toward the front of the reach, when it is desired to dump the load; and again thrown to its proper place after dumping, as set forth."

46. For an *Improvement in Washing Machines;* Joel Wisner, Aurora, New York.

Claim.—"I do not claim in general the use of a horizontal circular rotary wash-board in the bottom of a wash-tub, when they are used with the ordinary radial flutings, as such has been long known; but what I do claim is, making the said wash-board of a conical form, having its surface higher above the bottom of the tub at the circumference than at the centre, and attaching to it and to the bottom of the tub radial ribs of the form of a half cone, when these ribs are formed of such depth, and with spaces so wide between them, as to receive the clothes in those spaces in such manner as to turn or roll them over as the board is rotated back and forth, as described."

47. For *Improvements in Window Shutter Bolts;* Samuel Green, Assignor to Samuel Green and Cornelius Arnett, Salem, N. J.

Claim.—"What I claim is, the spring and drop bolt or tumbler, arranged with reference to each other, and the notch in the case, as described, and so formed and located that they may be acted upon in the manner described by a single key."

48. For an *Improvement in Manufacturing Ice;* Alexander C. Twining, Hudson, Ohio; patented in England, July 3, 1850.

Claim.—"I do not claim the exhaustion of a vessel containing ether and immersed in water, around which the water freezes, and to which the ether is returned after condensation in the restorer; but what I claim is, 1st, The combination of an exhausting pump or apparatus that is also condensing or compressing with a restorer and with a freezing cistern having water chambers, substantially as above. 2d, I claim the same pump and restorer in combination with a separate exhaust vessel, (the same whose connexion is indicated in the drawing,) by, in, or around which the ether or other liquid uncongealable at the temperature employed is cooled, and made to pass into the freezing cistern, and there perform its office, substantially as above. 3d, I claim the percolator, or apparatus, introducing into the cistern or the separate exhaust vessel, the ether or volatile liquid in jets or drops, as above, in combination with the exhaust pump and restorer. 4th, I claim the use of the water vessels in combination with the water chambers and the intervening liquid, for perfecting contact, as set forth. Finally, I claim, in combination with the restoring apparatus, the cooling of the liquid around the same, by exhaustion, using therefor the secondary pump and connexions, substantially as set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

A New Mode of Conducting the Daguerreotype Process. By W. H. Stanley Crawford.*

In the course of numerous experiments in the daguerreotype art, I found that after plates were prepared in the usual way with the vapors of iodine and bromine, ready for being impressed in the camera, there was a constant evaporation from their surfaces, to a greater or less extent; and this fact was most marked when I had prepared plates for views, &c., but which could not be used till several hours afterwards; in the latter case, the bromine, more volatile than the iodine, had evaporated more rapidly, and consequently the proportions between the two, so necessary for a good picture, were entirely destroyed. Another circumstance that struck me was, that if a plate were prepared well, and allowed to remain in the dark box *a few minutes* ere placing it in the camera, the resulting impression was always more sharply and better defined than if the plate had been immediately used; in the latter case, the impression being not unfrequently somewhat clouded in detail. These observations led me to the conclusion, that when under the ordinary process a plate was exposed in the camera, and the actinic rays allowed to act on its sensitive surface, the evaporation (above alluded to) being let loose in the camera, the vapors again attacked those portions of the surface affected by the actinic agency, and so prolonged the operation; for it is well known that the mixed vapors, so long as they exist, will, if allowed to fall on the plate, altogether, neutralize the effect of the actinic power. I hereupon set about thinking of some plan to remedy the defect, and eventually determined to allow

* From the London Journal of the Photographic Society, No. 9.

the plate to be acted upon *simultaneously* by the *actinic ray* and the *vapor of mercury* or *light transmitted by means of a yellow medium*, and the result *quite bore out* my expectation.

Having no apparatus adapted for carrying out my views neatly, I was put to make shift the best way I could, and I did thus: An ordinary camera was placed before the object to be taken, the focus nicely adjusted, and, immediately before inserting the dark box with the prepared plate, a thick cast iron cup, filled with mercury, was heated to the usual degree, and placed inside the camera; the slide of the dark box was then withdrawn, and the plate exposed by uncovering the lens. Pictures, by these means, were taken in a fraction of a second, giving a gain in time say in the ratio of one to five seconds over the ordinary way; the details were most sharply and beautifully delineated, and the pictures very firmly set on the plate, so much so, as to give much trouble to clean, even before being subjected to the fixing process. It will of course be understood, that, although the picture was taken in a fraction of a second, the plate had to remain at least five minutes afterwards in the camera, the point gained being simply that the parts affected by the actinic influence were immediately acted upon by the vapor of mercury, and thereby prevented from reabsorbing any of the loose vapors, and thus the resulting picture was not only expedited, but much improved.

I have now constructed a camera which simplifies the operation much, and which for a traveling daguerreotypist is a great improvement, as it does away with the necessity of a mercury box, and saves all the time and trouble of changing the plate from one box to another, pouring and repouring the mercury, &c. It is formed thus: A, fig. 1, is the usual

Fig. 1.

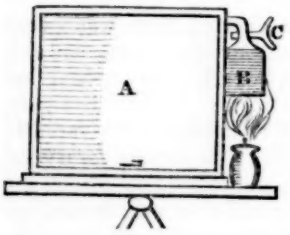
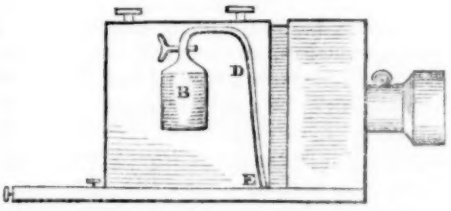


Fig. 2.



form of camera, showing a back view. B is a cast iron bottle of the capacity (for mercury) of say 3 or 4 ounces, and screwed in a convenient place, on about the centre of the hinder or sliding part of the camera; and C is a close fitting cock, to shut off or allow to escape the mercurial fumes when heated. Fig. 2, D, is a pipe, say of metal, bent from the upper part close to the side of the camera, and leading inside by a close fitting aperture, E. The working must now be obvious; the bottle, B, is placed rather well up on the side of the camera, to allow of its being conveniently heated with a spirit-lamp.

I have found the same results effected by admitting *light* into the camera through a yellow medium; but as this can only be done in *a strong light*, it would not be of such general use as the preceding plan.

I may mention here, that I am one of those who hold that it is the *color of the vapor* (yellow) of mercury which developes the latent picture on the plate, and not particles of mercury attaching themselves to the silver, as some affirm. The sun's rays, through a yellow or orange medium, act precisely in the same manner; but I cannot now enter upon my reasons, as it would occupy too much space and too much of your valuable time. With regard to the process that I have now communicated, it may be suggested that the mercurial vapor would injure, or, at all events, not improve the back lens, upon which, of course, it must of necessity fall in cameras constructed upon the present plan, though hitherto I have not found my lens affected at all; but to obviate any risk of such damage, the camera should have an air-tight partition of clear blue glass immediately in rear of the lens.

On the Determination of the Ammonia Contained in Waters. By M. Boussingault.*

Boussingault refers to the necessity of determining the quantities of ammonia contained in well water, river water, &c. Since the time (1802) when De Saussure ascertained the first traces of ammonia in the air, since Brandes (1825) discovered it in rain water, and especially since the time when Liebig distinctly proved this occurrence of ammonia, no complete investigations into the quantity of ammonia contained in natural waters has yet been made.

Boussingault has now begun to determine the ammonia in such waters by means of a distillatory apparatus. He regards it as certain that a water charged with a small quantity of ammonia will have given off the whole of this with the watery vapor when two-fifths of the water have distilled over.

We may, consequently, by submitting large quantities of water, as 10 litres or more, to a preliminary distillation, obtain a concentrated fluid, so as to treat this in the still set apart for the determination of the ammonia. Where the water is not too poor in ammonia, it may be placed in the apparatus itself.

The apparatus consists of a retort capable of containing 2–3 litres. A litre of the water to be examined is put into this, if necessary previously concentrated. The cooling of the distillate is effected by means of a glass worm tube. One-fifth is distilled off, and the quantity of ammonia contained in it ascertained, according to Peligot's method of determination of nitrogen by means of a solution of sulphuric acid of known strength. A second fifth is then distilled. In this there is generally no more ammonia, and the quantity found in the first portion is usually correct.

The normal solution of sulphuric acid for the determination of the ammonia is so composed that 5 cub. centims. of this fluid shall be saturated by 0·0106 of ammonia. As the alkaline fluid which serves for the testing of the solution is so far diluted that 33 cub. centims. of it saturate the 5 cub. centims. of dilute acid, 1 cub. centim. of the alkaline fluid

* From the London Chemical Gazette, No. 260.

represents 0·00032 of ammonia; and as the burette is divided into tenths of a cubic centimetre, one division represents 0·000032 of ammonia.

As regards the accuracy of the determination, it is necessary in this process to take care that the normal acid is first added to the fluid to be tested for ammonia, and that the alkaline fluid intended for the saturation of the acid is then poured in. Any inaccuracy must therefore arise from an error of two divisions of the burette. The determination of the ammonia can therefore only be brought within 0·06 milligrm.; but as the operation can always be performed twice, even if the errors of the two experiments do not compensate one another, the error of the method cannot exceed a tenth of a milligramme.

The author then instituted experiments to test this method. From these it appeared that distilled water to which a known quantity of ammonia had been added furnished more ammonia than had been mixed with it; so that, apparently, all distilled water contains ammonia. The water employed in the following experiments was distilled first with sulphate of alumina, and afterwards over potash, to remove any ammonia and carbonic acid that might be contained in it. In the following table the first column gives the number of the experiment, the second the quantity of ammonia added to the water, the third the quantity obtained from the distillate, and the fourth the difference between the two preceding:—

I.	II.	III.	IV.
1.	0·01233	0·01224	—0·00009
2.	0·00036	0·00037	+0·00001
3.	0·01056	0·01040	—0·00016
4.	0·01130	0·01131	+0·00001
5.	0·00836	0·00840	+0·00004
6.	0·04944	0·04950	+0·00006
7.	0·00413	0·00410	—0·00003

The following is a table of the quantities of ammonia ascertained by the author in various waters:—

Month.		Ammonia in 1 litre. grm.	1 cub. m. of water. grm.
April.	Water from the Seine (*au pont d'Austerlitz,*)	0·00012	0·12
April.	Water from the Seine (*au pont de la Concorde,*)	0·00016	0·16
April.	Water from Ourcq (*fontaine du Conservatoire,*)	0·00073	0·73
May.	Water from Ourcq (*fontaine du Conservatoire,*)	0·00003	0·03
Mar.	Water from the Canal de Loing (*à Montargis,*)	0·00032	0·32
April.	Water of the Bieber (*au Pont-aux-Tripes,*)	0·00261	2·61
April.	Water of the Arcueil, ...	0·00017	0·17
April.	Water from a well near Andilly (*Montmorency,*)	0·00003	0·03
May.	Water from the Lac d'Enghien, . . .	0·00007	0·07
April.	Water of a well near Guermantes (*Lagny,*)	0·00000	0·00

With the exception of the Bieber, which is rather an outlet for the numerous industrial establishments than a river, all the above waters contain less ammonia than rain water; the well near Lagny (*Seine-et-Marne*) contained none at all, or none that could be ascertained.

In the rain water collected on the terrace of the Observatory at Paris, Barral found on an average 3·35 milligrms. of ammonia to 1 litre of water. The greatest quantity that he met with was 5·45 milligrms. Boussingault

has hitherto made but few determinations of the ammonia in rain water, but these agree well with Barral's. Thus in the first week of April he found 4·34 milligrms. in 1 litre of rain water at Paris. This is twenty-seven times as much as existed at the same time in the Seine water. On the 7th of May the rain water contained 0·0032 grm. in 1 litre.

The water of the Lac d'Enghien, according to the above table, contains a tenth of a milligramme of ammonia in 1 litre. A spring which rises near this lake contains 5·06 milligrams. Considered as bicarbonate of ammonia, this gives 0·0181 of the salt; it is possible that this assists the medicinal action of the sulphurous water of Enghien.

In 1 litre of sea water from near Dieppe the author found 0·00020 grm. of ammonia. If we consider that two-thirds of the surface of the globe are covered with water, the sea always contains a considerable quantity of ammonia, which may return again into the atmosphere.

In places where great numbers of people live, the quantity of ammonia in the soil must increase. The investigation of the following spring waters proves this:—

	In 1 litre. grm.	In 1 cub. metre. grm.
Spring in a garden (*Jardin de Clignancourt*) outside Paris,	0·00032	0·32
Spring of a house in the *Rue du Parc-Royal*,	0·00132	1·32
Spring of a house in the *Place de l'Hotel-de-Ville*,	0·03435	34·35
Spring of a house *Quai de la Mégisserie*, No. 30,	0·03033	30·33
Spring of a house *Quai de la Mégisserie*, No. 28,	0·03386	33·86
Spring of a house in the *Rue de la Tabletterie*,	0·00026	0·26

The Parisian well water is not drinkable. It is very hard, decomposes soap, and is not fit for boiling vegetables. It has in general no smell; the great quantity of ammonia contained in this water may nevertheless arise from dung or other decaying organic matters.

The author collected some snow in March, immediately after its falling on a terrace, and thirty-six hours afterwards some from the fertile earth of a garden. On determining the ammonia contained in the water resulting from the melting of the snow, he found in the

	In 1 litre.	In 1 cub. metre.
Snow from the terrace,	0·00178	1·78
Snow from the garden,	0·01034	10·34

The large quantity of ammonia in the snow from the garden must apparently have passed into it from the soil.—*Comptes Rendus*, vol. xxxvi. p. 814.

For the Journal of the Franklin Institute.

Steam Logs of the Pacific, Collins Steamer, plying between New York and Liverpool. By B. F. Isherwood, Chief Eng., U. S. N.

The four steamers composing the Collins line, viz: the *Pacific*, *Atlantic*, *Baltic*, and *Arctic*, have all about the same linear dimensions and displacements, though they are not modeled precisely alike; for instance, the bow of the *Atlantic* is sharper than the bow of the *Pacific*, but the stern of the *Pacific* is finer than the stern of the *Atlantic*. The engines of

the first two are alike, and those of the last two only differ from them in length of stroke of piston, the former having nine feet, and the latter ten feet stroke. The boilers of all four vessels are of the same type and general arrangements, but differ considerably in their proportions; the boilers of the *Pacific* and *Atlantic* are alike; those of the *Baltic* and *Arctic* are alike also, but are larger than those of the former vessels, with a view to supply a proportionally increased amount of steam for their greater capacity of cylinder.

To the kindness of Engineer-in-Chief D. B. Martin, U. S. N., who was for some time Chief Engineer of the *Pacific*, I am indebted for the steam logs of that vessel for the voyages made by him, and for an accurate drawing of the boiler, taken from actual measurement; also, for a large number of indicator diagrams, showing the exact quantity of steam used, &c. Believing this information to have considerable practical value, I have arranged it for the *Journal*, and added the dimensions of the hull and machinery of the vessel. In a previous number of the *Journal*, and by the kindness of the same gentleman, I gave similar information regarding the *Arctic*, and as the *Atlantic* and *Baltic* are nearly duplicates of the *Pacific* and *Arctic*, the present information covers with sufficient exactness the performance of all the vessels of this celebrated line.

HULL.

Length extreme,	290 feet.
" on deck,	282 "
" between perpendiculars,	280 "
" on keel,	271 "
Beam on deck, extreme,	45 " 6 in.
Depth of hold to spar deck,	32 "
" " main deck,	24 "
Burthen by custom-house measurement,	2775 tons.
Mean draft of water with half coal in and other weights full,	19 feet.
Immersed amidship section, at 19 feet draft,	685 sq. feet.
Displacement at 19 feet draft,	3724 tons.
" per inch of draft at 19 feet draft,	22 "

ENGINES.—Two side lever, condensing engines, with balance-puppet valves and a fixed cut-off, cutting off at four feet from the commencement of the stroke.

Diameter of cylinders,	95 inches.
Stroke of pistons,	9 feet.
Space displacement of both pistons per stroke,	886.032 cubic ft.
Steam space between cut-off valves and pistons at one end of both cylinders,	25 "

PADDLE WHEELS—Of the common or radial kind.

Diameter from outside to outside of paddles,	35 ft. 6 in.
Length of each paddle,	10 " 6 "
Width of each paddle,	21½ inches.
Immersion of lower edge of paddle at 19 feet draft of vessel,	7 feet.
Number of paddles in one wheel,	28.
" " water in one wheel at 19 feet draft of vessel,	7.
Area of two paddles,	37.625 sq. feet.
" all immersed paddle surface at 19 feet draft of vessel,	263.375 " "
Proportion of area of two paddles to area of immersed amidship section of hull at 19 feet draft,	1·000 to 18·206
Proportion of area of all immersed paddle surface to area of immersed amidship section of hull at 19 feet draft,	1·000 to 2·601

BOILERS.—Four iron boilers with vertical tubes. The water is con-

tained within and the fire is applied without the tubes. The boilers are placed in pairs, back to back, with one chimney in common. The forward and after pair are alike, except in breadth, breadth of furnace, and number of tubes; each forward pair being 12 feet 10 inches broad, with furnaces 30 inches broad, and containing 1184 tubes; and each after boiler being 14 feet broad, with furnaces 33½ inches broad, and containing 1332 tubes; making 5032 tubes in the four boilers. The tubes are of iron, and 2 inches in external diameter; 2516 are 5 feet long, and 2516 are 4 feet 6 inches long. Distance between centres of tubes lengthways the boiler, 2·944 inches; crossways the boiler, 3·5625 inches. Opposite each double furnace of the after pair of boilers, there are nine rows of tubes—of the forward pair, eight rows—in each row of both pairs there are 37 tubes.

Length of each boiler, (exclusive of connexions,)			21 feet 5 inches.
Height of each boiler, (exclusive of steam chimney,)			13 " 8 "
Breadth of each forward boiler,			12 " 10 "
" " after boiler,			14 "
Number of furnaces in each boiler,			8
Heating surface in furnaces of the two forward boilers,		1864·0 sq. ft.	
" " tube boxes of " " "		944·0 "	
" " back connexion " " "		697·4 "	
" " tubes of " " "		5889·3 "	
Total heating surface " " "			9394·7 sq. ft.
Heating surface in the furnaces of two after boilers,		2000·0 "	
" " tube boxes " " "		974·0 "	
" " back connexions " "		733·0 "	
" " tubes " " "		6625·4 "	
Total heating surface " " "			10332·4 "
Total heating surface in the four boilers,			19727·1 "
Grate surface in the two forward boilers,			230·00 sq. ft.
" " " after "			256·83 "
Total grate surface in the four boilers,			486·83 "
Aggregate cross area between tubes in two forward boilers,		44·333 sq. ft.	
" " " " after "		49·083 "	
Total in the four boilers,			93·416 "
Total " " of the spaces between the line produced of the bottom of the tubes and hanging bridge at the back of the four boilers,			63·500 "
Cross area of the smoke chimney,			78·54 "
Height of the smoke chimney above the grates,			75 feet.
Capacity of steam room in the four boilers,			3630 cub. ft.
Weight of sea water contained in the four boilers, (calculated,)			244,400 lbs.

PROPORTIONS.

Proportion of heating to grate surface,	40·521 to 1·000
" " grate surface to aggregate cross area between tubes,	5·211 "
" " " " " " the line produced of the bottom of the tubes and hanging bridges at back of boilers,	7·667 "
" " grate surface to cross area of the smoke chimney,	6·198 "

Fifth Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boiler per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 lbs.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Jan. 23	13·3	12·24	17320	23 35	80	255	41° 16′	68° 26′	During this voyage, Cumberland bituminous coal was burned, but it furnished steam in such insufficient quantities that the engines were compelled to be run with the throttle only ¼ open.
" 24	13·0	12·61	17845	23 35	58	287	42 59	62 22	
" 25	14·7	13·44	19015	23 35	64	285	45 21	58 07	
" 26	12·6	12·60	17775	23 30	58	285	46 12	50 57	
" 27	11·8	11·43	16105	23 29	50	161	46 56	47 22	
" 28	14·4	13·80	19352	23 22	60	290	47 58	39 58	
" 29	9·6	12·30	17475	23 41	51	259	48 36	33 36	
" 30	9·5	12·02	17025	23 37	52	270	49 00	27 38	For the greater part of the voyage there was a gale on the port quarter.
" 31	10·2	12·19	17235	23 33	54	261	49 34	19 59	
Feb. 1	10·2	11·34	16057	23 36	58	237	49 55	13 29	
" 2	11·5	13·37	18853	23 30	65	278			
" 3	11·5	12·90	18283	23 30	60	270			
Totals,			212340	282 33	710	3138			
Means,	11·9	12·525			5629lb. per h'r.	11·106 per h'r.			

Fifth Voyage from Liverpool to New York.

Feb. 23	13·6	10·90	13785	21 04	55	} 482			
" 24	15·0	11·46	16725	24 19	66				
" 25	15·2	11·93	17835	24 55	65	273	48° 34′	28° 05′	
" 26	15·4	11·94	17490	24 25	66	273			
" 27	15·0	11·76	17225	24 25	67	256	47 09	34 21	
" 28	15·2	11·82	17270	24 21	62	218	46 14	38 50	
Mar. 1	15·4	13·46	19751	24 27	68	300	44 06	45 30	Weather not noted on this voyage.
" 2	15·8	12·19	17859	24 25	63	238	42 56	50 00	
" 3	15·0	14·23	20868	24 27	72	311	42 42	57 28	
" 4	13·0	11·24	16408	24 20	56	214	42 49	62 18	
" 5	14·3	13·70	20001	24 20	67	266	41 24	67 16	
" 6	15·0	14·63	21250	24 12	72	283			
" 7	16·0	13·76	4350	5 16	15	58			
Totals,			220820	294 56	774	3205			
Means,	14·9	12·480			6035lb. per h'r.	10·857 per h'r.			

Sixth Voyage from New York to Liverpool.

DATE. 1851.	Av. steam pres. in boil. per sq. in. above atmos. in pounds.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made per minute.	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Mar. 20	16·9	13·04	18415	23 32	63	256	40° 28′	68° 26′	During this voyage, Cumberland bituminous coal was burned, but it furnished steam in such insufficient quantities that the engines were compelled to be run with the throttles partly closed. Weather not noted on this voyage.
" 21	15·2	12·75	18025	23 34	68	286	41 11	62 06	
" 22	15·6	12·79	17940	23 23	70	275	41 14	56 00	
" 23	15·7	13·34	18784	23 28	74	290	42 10	49 07	
" 24	15·3	13·00	18306	23 28	72	275	43 01	43 01	
" 25	15·0	13·05	18370	23 27	74	284	45 17	36 25	
" 26	13·2	13·43	18970	23 32	77	299	47 34	30 09	
" 27	13·0	13·32	18784	23 30	73	276	49 32	24 33	
" 28	14·0	13·84	19425	23 21	74	280	51 03	17 38	
" 29	13·8	13·78	19315	23 22	76	290	Cape Clear.		
" 30	14·4	15·42	22212	24 00	76	333			
Totals,			208546	258 37	797	3144			
Means,	14·7	13·440			7280lb. per h'r.	12·157 per h'r.			

Sixth Voyage from Liverpool to New York.

Ap. 10	16·9	14·78	18301	22 18	65	272			
" 11	17·2	14·09	20692	24 28	63	308	50° 54′	17° 21′	
" 12	17·2	14·07	20820	24 40	66	310	49 29	25 23	
" 13	16·8	14·23	21090	24 42	71	306	48 15	32 48	Fine weather, and vessel under all sail during the whole voyage.
" 14	17·1	14·70	21615	24 30	69	328	46 29	40 14	
" 15	17·0	14·87	21845	24 29	75	318	44 57	48 02	
" 16	17·0	15·35	22480	24 25	73	316	43 46	55 04	
" 17	14·2	14·30	20925	24 23	69	300	42 39	61 42	
" 18	15·0	15·00	22020	24 29	70	302			
" 19	16·0	16·46	21722	22 00	75	296			
Totals,			211510	240 24	696	3056			
Means,	16·4	14·664			6485lb. per h'r.	12·712 per h'r.			

Seventh Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 pounds.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
May 11	16·4	13·48	19012	23 30	62	300			
" 12	17·4	14·39	20285	23 29	67	312	42° 53′	61° 22′	During this voyage, a superior lot of picked Pennsylvania anthracite was burned.
" 13	17·6	15·00	21180	23 33	73	302	45 02	55 00	
" 14	17·0	15·22	21480	23 31	74	305	46 30	48 05	
" 15	16·0	14·52	20508	23 32	74	293	47 38	41 25	
" 16	15·0	14·44	20372	23 31	78	299	48 32	34 40	
" 17	16·6	15·57	22002	23 33	75	306	49 28	27 29	
" 18	15·7	16·35	22810	23 15	76	320	51 12	18 50	Weather not noted on this voyage.
" 19	15·0	15·75	22048	23 20	79	314	51 31	10 32	
" 20	16·3	17·28	24880	24 00	80	327	Channel.		
Totals,			214577	235 14	738	3078			
Means,	16·3	15·203			7028lb. per h'r.	13·085 per h'r.			

Seventh Voyage from Liverpool to New York.

May 29	16·5	12·14	19310	26 30	64	314	55° 19′	10° 20′	
" 30	16·0	13·32	19575	24 30	69	282	54 24	18 11	Heavy head sea.
" 31	16·7	14·17	20828	24 30	69	312	53 17	26 48	Light head wind.
June 1	16·0	14·49	21297	24 30	79½	308	51 47	34 40	" "
" 2	16·3	14·60	21465	24 30	81½	301	49 54	41 20	" "
" 3	16·0	15·54	22844	24 30	77	318	48 31	49 00	Beam wind and sea.
" 4	15·6	14·39	21150	24 30	82	290	46 11	55 13	H'vy head wind & sea.
" 5	16·6	15·65	23000	24 30	88	312	44 21	62 04	" " "
" 6	16·7	16·70	24555	24 30	86	324	41 50	68 36	Light head wind & sea.
" 7	15·7	17·28	25125	24 14	90	332			" " "
Totals,			219149	246 44	786	3093			
Means,	16·2	14·480			7136lb. per h'r.	12·536 per h'r.			

Eighth Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 lbs.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
June 22	17·0	13·43	18824	23 22	68	286	40° 54′	68° 07′	Light w'd & sm'th sea.
" 23	17·8	13·62	19135	23 25	72	292	43 36	62 36	Light h'd w'd & mod "
" 24	18·0	14·21	20210	23 42	74	296	46 00	56 58	" " "
" 25	17·3	14·70	20848	23 39	76	298	47 15	50 00	" " "
" 26	17·8	15·17	21387	23 30	79	297	48 39	42 54	" " "
" 27	17·3	15·47	21885	23 35	82	304	49 50	35 22	" " "
" 28	17·1	15·15	21360	23 30	86	288	50 36	27 59	Fresh h'd w'd & hvy "
" 29	16·7	15·63	22100	23 34	92	297	51 25	20 16	Mod h'd w'd & mod "
" 30	17·0	16·31	23150	23 39	89	308	51 23	12 07	Light h'd w'd & sm'th"
July 1	16·5	16·79	23150	23 00	89	328	Chan-	Holy-	" " "
" 2	not noted.	17·34	7005	6 44	35	100	nel.	head.	
Totals,			219054	241 30	842	3094			
Means,	17·3	15·118			7810lb. per h'r.	12·812 per h'r.			

Eighth Voyage from Liverpool to New York.

July 10	18·0	12·75	15116	19 46	60	225	Balacotton.		
" 11	18·0	13·07	19229	24 31	68	286	51° 27′	15° 34′	Fresh br. ahd, mod sea
" 12	17·9	13·27	19495	24 30	70	280	51 23	23 01	Strong " " hvy "
" 13	16·3	11·03	16162	24 25	59	208	51 16	28 35	Hvy gale " " "
" 14	17·0	13·27	19500	24 30	71	282	50 28	35 28	Strong w'd " " "
" 15	17·0	14·27	20995	24 32	81	311	49 39	43 20	Mod. wind " mod. "
" 16	17·5	14·67	21511	24 26	86	294	48 53	50 43	" " "
" 17	17·0	14·10	7614	9 00	31	122	45 38	54 50	Strong w'd " " "
Means, *	17·3	13·247			6707lb. per h'r.	11·431 per h'r.			

Performance with Starboard Engine alone, after the breaking down of the other, cutting off the Steam at seven-ninths the Stroke.

July 17	11·0	9·00	8280	15 20	30	132	45° 38′	54° 50′	Strong wd. a'd, m'd sea
" 18	13·7	10·31	15068	24 18	47	210	44 37	59 34	Mod. h'd. w'd. and sea
" 19	14·2	10·60	15503	24 23	45	195	43 56	63 58	" " "
" 20	13·9	10·90	15880	24 16	43	200	41 28	67 13	" " "
" 21	14·0	10·73	15677	24 21	43	227	40 40	72 00	" " "
" 22	14·0	11·92	6676	9 20	20	97			
Means, †	13·5	10·533			4187lb. per h'r.	8·863 per h'r.			

* Before port engine broke.
† After port engine broke.

Ninth Voyage from New York to Liverpool.

DATE. 1851.	Average steam pressure in boilers per sq. inch above atmos. in lbs.	Average number of double strokes of piston made per minute.	Total number of double strokes of piston made.	Time—Hours and minutes.	Coal consumed in tons of 2240 lbs.	Geographical miles run by observation.	Latitude.	Longitude.	REMARKS.
Aug 17	16·0	12·81	14855	19 20	65	245	43° 48′	69° 11′	This day lost 4¼ hs. by run'g into a brig.
" 18	17·6	13·52	17545	21 38	74	269	42 58	64 00	This day stop'd 1½ hs. Light brez ah'd.
" 19	17·3	13·94	19612	23 27	76	294	45 48	58 56	Light fair wd. mod sea
" 20	16·8	14·02	19913	23 40	83	302	45 56	52 04	" " "
" 21	16·5	14·02	19854	23 35	80	311	48 22	44 38	Mod. " "
" 22	17·2	14·34	20188	23 28	83	311	49 54	37 05	" " "
" 23	17·0	15·41	21668	23 26	84	310	50 52	29 05	Mod b'm wd., mod sea.
" 24	17·0	15·36	21664	23 30	81	310	51 35	21 19	" " " "
" 25	17·2	15·92	22446	23 30	84	308	51 20	13 10	" " h'vy "
" 26	15·7	16·11	22780	23 34	81	312	Channel.		Mod gale abm, h'vy "
" 27	16·6	15·85	8762	8 40	4	120	Liverpool.		
Totals,			209278	238 08	795	3072			
Means,	16·8	14·647			7478lb. per h'r.	12·294 per h'r.			

Ninth Voyage from Liverpool to New York.

Sept. 4	17·4	13·0	17731	22 21	65	265	Channel.		Light h'd wd smth se
" 5	17·6	13·75	20269	24 34	78	310	52° 01′	17° 19′	Mod. fair w'd., mod. "
" 6	17·3	13·81	20264	24 27	81	312	51 36	25 40	" " "
" 7	17·1	13·41	19705	24 29	82	265	51 19	32 41	Mod gale ahd., h'vy "
" 8	17·4	13·63	20093	24 34	84	270	50 41	39 15	" " "
" 9	16·3	12·06	17632	24 22	62	222	49 45	44 50	Hvy gale ah'd, h'vy "
" 10	17·0	14·79	21705	24 28	87	291	47 36	51 23	Light h'd w'd, mod. "
" 11	16·6	16·15	23712	24 28	84	326	45 19	58 35	" " sm'th "
" 12	16·7	16·03	23533	24 28	81	318	42 22	64 39	Mod. h'd. w'd., mod. "
" 13	17·0	16·51	24100	24 20	84	312	40 50	71 15	" " "
" 14	14·5	18·67	13720	12 15	55	178	New York.		" " "
Totals,			222464	254 46	843	3069			
Means,	16·9	14·553			7412lb. per h'r.	12·047 per h'r.			

Summary of the Steam Logs.—From New York to Liverpool.

Voyage.	DATE.	TOTALS. Total number of double strokes of piston made.	TOTALS. Total time from dock to dock—Hours and minutes.	TOTALS. Total coal consumed in tons of 2240 pounds.	TOTALS. Total geographical miles run by observation.	MEANS. Mean Steam pressure in boilers per sq. in. above atmosphere in pounds.	MEANS. Mean number of double strokes of piston made per minute.	MEANS. Mean number of pounds of coal consumed per hour.	MEANS. Mean speed of the vessel per hour in geo. miles of 6082⅔ feet.
	Burning Cumberland Bituminous Coal.								
5th.	J'n. & F'b. '51.	212340	282 33	710	3138	11·9	12·525	5629	11·106
6th.	March, "	208546	258 37	797	3144	14·7	13·440	7280	12·157
	Means,	210443	270 35	753½	3141	13·2	12·962	6418	11·608
	Burning Pennsylvania Anthracite.								
7th.	May, '51.	214577	235 14	738	3078	16 3	15·203	7028	13·085
8th.	June & July "	219054	241 30	842	3094	17·3	15·118	7810	12·812
9th.	August, "	209278	238 08	795	3092	16·8	14·647	7478	12·294
	Means,	214303	238 17	791⅔	3088	16·8	14·988	7442	12·729
	Burning Welsh Anthracite.								
5th.	F'b. & Mar. '51	220820	294 56	794	3205	14·9	12·480	6035	10·857
6th.	April, "	211510	240 24	696	3056	16·4	14·664	6485	12·712
7th.	May & June,"	219149	246 44	786	3093	16·2	14·480	7136	12·536
8th.	July, "	216706	—	—	3069	—	—	—	—
9th.	September, "	222464	254 46	843	3069	16·9	14·553	7412	12·047
	Means,	218130	259 12	779⅔	3098 4/10	16·0	13·972	6745	11·979

From the above summary, if we omit the steam and fuel items of the fifth and sixth voyages from New York to Liverpool, in which the kind of fuel used did furnish sufficient steam to work the engines with wide throttles, it appears that the mean distance run in crossing is 3104 geographical miles. The distance by Mercator is 3084, and by Mercator and great circle 3023 geographical miles; there was consequently an increase of 81 miles above the shortest distance, or 2·68 per centum of that distance. The mean number of revolutions of the wheels required to make the passage from New York to Liverpool is 212,759; to make the passage from Liverpool to New York, 218,130, or 2·52 per centum of the former more. The mean consumption of anthracite coal per voyage is 785 tons of 2240 pounds. The mean pressure of steam carried in the boilers per square inch above the atmosphere is 16 pounds. The mean speed of the vessel in the voyages from New York to Liverpool is 12·729 geographical miles per hour; in the voyages from Liverpool to New York, 11·979 miles per hour, or a less speed by 6·26 per centum of the latter. The mean number of revolutions of the wheels made per minute during the voyages from New York to Liverpool is 14·988; in the voyages from Liverpool to New York, 13·972, or 7·27 per centum of the latter.

In the following Table of Results, the cylinder pressures are as given by the indicator; and in the calculation of the evaporation by the fuel, there is included the loss by *blowing off* sufficient quantities of water to maintain it at one and three-quarters the natural concentration; also, the steam required to fill the nozzles and clearance of the cylinder. The temperature of the feed water was carried at 110° F. The latent heat of steam is taken from Regnault's experiments.

The loss of effect by the oblique action of the paddle is calculated as the squares of the series of their angles of incidence on the water.

Table of the Results from the Performance of the Pacific.

	From New York to Liverpool.		From Liverpool to New York, burning Welsh anthracite.
	Burning Cumberland bituminous coal.	Burning Pennsylvania anthracite.	
OBSERVED.			
Speed of vessel per hour in geographical miles of 6082¾ feet,	11·608	12·729	11·979
Revolutions of the wheels per minute,	12·962	14·988	13·972
Steam pressure in boilers above atmosphere in pounds per square inch,	13·2	16·8	16·0
Steam pressure (initial) in cylinders above atmosphere in pounds per square inch,	9·2	14·1	13·3
Pounds of coal consumed per hour,	6418·	7442·	6745·
Tons of coal consumed per 24 hours,	68·764	79·736	72·268
CALCULATED.			
Mean effective pressure on pistons in pounds per square inch,	14·49	18·32	17·70
Horse power developed by the engines,	1450·65	2122·01	1912·33
Slip of the centre of pressure of the paddle in per centums of its speed,	15·62	19·98	19·22
Oblique action of the paddles,	21·63	21·63	21·63
Pounds of steam evaporated per hour, from sea water of 1¾ the natural concentration, with temperature of feed water 110° F., by 1 pound of coal; including loss by *blowing off* to maintain the water at that concentration, and loss by waste steam in nozzles and clearances of cylinders,	7·070	8·445	8·494
Pounds of coal consumed per hour per square foot of grate furnace,	13·183	15·287	13·855

From the above table, it will be perceived that the boilers had a very high evaporative efficiency, probably as high as can be practically obtained. It also shows that the evaporative power of equal weights of Pennsylvania and Welsh anthracites was sensibly the same, and greatly higher than the result from the Cumberland bituminous coal. Taking the mean result of the two anthracites, and comparing it with the result from the Cumberland coal, the evaporative efficiency of the former exceeds that of the latter by $19\frac{8}{10}$ per centum of the latter, and the *Pacific* owes the speed she made on the two voyages with Cumberland coal, principally to very favorable weather; which is further evidenced by the small amount of slip (only 15·62) made by the wheels on those passages.

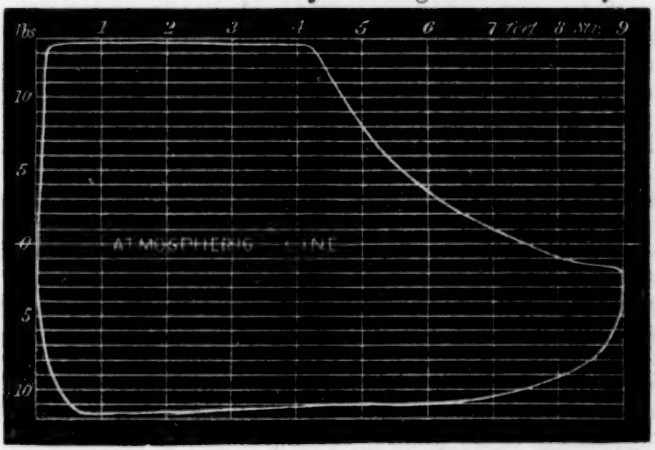
By referring to the *Journal* for last January, page 42, the fixed carbon

in Pennsylvania anthracite is given at 88·540 per centum, and in Welsh anthracite at 88·882 per centum, the mean of which is 88·711. The fixed carbon in Cumberland bituminous coal is 75·05 per centum for a mean of five varieties, as determined by Professor Walter R. Johnson. *The per centage of fixed carbon in the anthracites, therefore, exceeds its per centage in the Cumberland coal by* 18·2 *per centum of the latter. We have already seen that the evaporative efficiency of the anthracites exceeds that of the Cumberland coal by* 19·8 *per centum of the latter; or the evaporative efficiency of the two kinds of coal is sensibly in the proportion of their fixed carbon—a law well supported by a vast mass of experiments on steam boilers, with but an occasional exception, and now universally acknowledged by the best European authorities.*

The foregoing result is derived from the combustion of 1507 tons of Cumberland coal and 5494 tons of Anthracite, burned by expert engineers and firemen, under circumstances in which no efforts were spared to obtain the highest results from each.

By referring to the *Journal* for January last, where an account of the *Arctic* is given, it will be seen that the boilers of that vessel had a much less economical evaporation than the boilers of the *Pacific*. Now, the boilers of the two vessels are precisely alike in type and general proportions, the principal difference being that the vertical tubes, composing the chief part of the heating surface, are six inches the longest in the *Arctic*. The length of travel of the heated gases is the same in both vessels, as is also the area and height of the smoke chimney. Now, the fuel was of the same kind, and burned under the direction of the same engineer, and yet the *Pacific's* economical evaporation was 13 per centum of the *Arctic's* greater than the *Arctic's*.

Indicator Diagram.—The subjoined diagram shows a very fair ave-



rage of all, taken from both ends of the two cylinders. They differ very slightly in difference from boiler pressure and in point of cutting off. The leading features of the diagram are a want of lead on the steam, and a cushioning on the exhaust. With this *set* of the valves, the engines were found to give their most satisfactory performance.

On some of the Eruptive Phenomena of Iceland. By Dr. JOHN TYNDALL, F. R. S.*

The Lecturer adverted to the Geisers; and proposed, as his time was limited, to confine his attention to the Great Geiser. We have here a tube ten feet wide and seventy feet deep; it expands at its summit into a basin, which from north to south measures fifty-two feet across, and in the perpendicular direction sixty feet. The interior of the tube and basin is coated with a beautiful smooth plaster, so hard as to resist the blows of a hammer. The first question that presents itself is, how was this wonderful tube constructed? How was this perfect plaster laid on? A glance at the constitution of the Geiser water will perhaps furnish the first surmise. In 1000 parts of the water the following constitutents are found:

Silica,	0·5097
Carbonate of soda,	0·1939
Carbonate of ammonia,	0·0083
Sulphate of soda,	0·1070
Sulphate of potash,	0·0475
Sulphate of magnesia,	0·0042
Chloride of sodium,	0·2521
Sulphate of sodium,	0·0088
Carbonic acid,	0·0557

The lining of the tube is silica, evidently derived from the water; and hence the conjecture may arise that the water deposited the substance against the sides of the tube and basin. But the water deposits no sediment even when cooled down to the freezing-point. It may be bottled up and kept for years as clear as crystal, and without the slightest precipitate. A specimen brought from Iceland and analyzed in this Institution was found perfectly free from sediment. Further, an attempt to answer the question in this way would imply that we took it for granted that the shaft was made by some foreign agency and that the spring merely lined it. A painting of the Geiser, the property of Sir Henry Holland, himself an eye-witness of these wonderful phenomena,—was exhibited. The painting, from a sketch taken on the spot, might be relied on. We find here that the basin rests upon the summit of a mound; this mound is about forty feet in height, and a glance at it is sufficient to show that it has been deposited by the Geiser. But in building the mound, the spring must also have formed the tube which perforates the mound; and thus we learn that the Geiser is the architect of its own tube. If we place a quantity of the Geiser water in an evaporating basin, the following takes place: in the centre the fluid deposits nothing; but at the edges, where it is drawn up the sides of the basin by capillary attraction, and thus subjected to a quick evaporation, we find silica deposited; round the edges we find a ring of silica thus laid on, and not until the evaporation is continued for a considerable time, do we find the slightest turbidity in the central portions of the water. This experiment is the microscopic representant, if the term be permitted, of nature's operations in Iceland. Imagine the case of a simple thermal spring whose waters trickle over its side down a gentle incline; the water thus exposed evaporates speedily, and silica is deposited. This deposit gradually elevates the side over

* From the London, Edinburgh, and Dublin Philos. Magazine, August, 1853.

which the water passes until finally the latter has to choose another course; the same takes place here, the ground becomes elevated by the deposit as before, and the spring has to go forward—thus it is compelled to travel round and round, discharging its silica and deepening the shaft in which it dwells, until finally, in the course of centuries, the simple spring has produced that wonderful apparatus which has so long puzzled and astonished both the traveler and the philosopher.

Before an eruption, the water fills both the tube and basin, detonations are heard at intervals, and after the detonation a violent ebullition in the basin is observed; the column of water in the pipe appears to be lifted up, thus forming a conical eminence in the centre of the basin and causing the water to flow over its rim. The detonations are evidently due to the production of steam in the subterranean depths, which rising into the cooler water of the tube, becomes condensed, and produces explosions similar to those produced on a small scale when a flask of water is heated to boiling. Between the interval of two eruptions, the temperature of the water in the tube towards the centre and bottom gradually increases. Bunsen succeeded in determining its temperature a few minutes before a great eruption took place; and these observations furnished to his clear intellect the key of the entire enigma. A little below the centre the water was within two degrees of its boiling point, that is, within two degrees of the point at which water boils under a pressure equal to that of an atmosphere, *plus the pressure of the superincumbent column of water.* The actual temperature at thirty feet above the bottom was 122° Centigrade; its boiling point here is 124°. We have just alluded to the detonations and the lifting of the Geiser column by the entrance of steam from beneath. These detonations and the accompanying elevation of the column are, as before stated, heard and observed at various intervals before an eruption. During these intervals the temperature of the water is gradually rising; let us see what *must* take place when its temperature is near the boiling point. Imagine the section of water at thirty feet above the bottom to be raised six feet by the generation of a mass of vapor below. The liquid spreads out in the basin, overflows its rim, and thus the elevated section has six feet less of water pressure upon it; its boiling point under this diminished pressure is 121°; hence in its new position, its actual temperature (122°) is a degree above the boiling point. This excess is at once applied to the generation of steam; the column is lifted higher, and its pressure further lessened; more steam is developed underneath; and thus, after a few convulsive efforts, the water is ejected with immense velocity, and we have the Geiser eruption in all its grandeur. By its contact with the atmosphere the water is cooled, falls back into the basin, sinks into the tube, through which it gradually rises again, and finally fills the basin. The detonations are heard at intervals, and ebullitions observed; but not until the temperature of the water in the tube has once more nearly attained its boiling point is the lifting of the column able to produce an eruption.

In the regularly formed tube the water nowhere quite attains the boiling point. In the canals which feed the tube, the steam which causes the detonation and lifting of the column must therefore be formed. These

canals are in fact nothing more than the irregular continuation of the tube itself. The tube is therefore the sole and sufficient cause of the eruptions. Its sufficiency was experimentally shown during the lecture. A tube of galvanized iron six feet long was surmounted by a basin; a fire was placed underneath and one near its centre to imitate the lateral heating of the Geiser tube. At intervals of five or six minutes, throughout the lecture, eruptions took place: the water was discharged into the atmosphere, fell back into the basin, filled the tube, became heated again, and was discharged as before.

Sir Geo. Mackenzie it is well known was the first to introduce the idea of a subterranean cavern to account for the phenomena of the Geiser. His hypothesis met with general acceptance, and was even adopted undoubtingly by some of those who accompanied Bunsen to Iceland. It is unnecessary to introduce the solid objections which might be urged against this hypothesis, for the tube being proved sufficient, the hypothetical cavern disappears with the necessity which gave it birth.

From the central portions of the Geiser tube downwards, the water has stored up an amount of heat capable, when liberated, of exerting an immense mechanical force. By an easy calculation it might be shown that the heat thus stored up could generate, under ordinary atmospheric pressure, a column of steam having a section equal to that of the tube and a height of nearly *thirteen hundred yards*. This enormous force is brought into action by the lifting of the column and the lessening of the pressure described above.

A moment's reflection will suggest to us, that there must be a limit to the operations of the Geiser. When the tube has reached such an altitude that the water in the depths below, owing to the increased pressure, cannot attain its boiling point, the eruptions of necessity cease. The spring however continues to deposite its silica, and forms a *laug* or cistern. Some of these in Iceland are of a depth of thirty or forty feet. Their beauty is indescribable; over the surface a light vapor curls; in the depths the water is of the purest azure, and tints with its own hue the fantastic incrustations on the cistern walls; while at the bottom is observed the mouth of the once mighty Geiser. There are in Iceland traces of vast, but now extinct, Geiser operations. Mounds are observed whose shafts are filled with rubbish, the water having forced a way underneath and retired to other scenes of action. We have in fact the Geiser in its youth, manhood, old age, and death, here presented to us:—in its youth, as a simple thermal spring, in its manhood as the eruptive spring, in its old age as the tranquil *laug*, while its death is recorded by the ruined shaft and mound which testify the fact of its once active existence.

Next to the Great Geiser the Stokkur is the most famous eruptive spring of Iceland. The depth of its tube is forty-four feet. It is not however cylindrical like that of the Geiser, but funnel shaped. At the mouth it is eight feet in diameter, but it diminishes gradually, until near the centre the diameter is only ten inches. By casting stones and peat into the tube and thus stopping it, eruptions can be forced which in point of height often exceed those of the Great Geiser. Its action was illustrated experimentally in the lecture, by stopping the galvanized iron tube before

alluded to loosely with a cork. After some time the cork was forced up, and the pent-up heat converting itself suddenly into steam, the water was ejected to a considerable height; thus demonstrating that in this case the tube alone is the sufficient cause of the phenomenon.

On the Condensation of Gases at the Surface of Solid Bodies. By MM. J. Jamin and A. Bertrand.*

In the various experiments intended to establish the physical theory of gases, it is implicitly supposed that their state of equilibrium is not influenced by the walls of the vessels in which they are contained; it is supposed that no attractive or repulsive force exists between solid and gaseous molecules. Nevertheless, the general principles of molecular physics do not justify our thinking that this can be the case; we have no reason to suppose that gases are deprived of a property so energetically manifested by liquids; and if it were so, we could not explain many phenomena which only require to be generalized in order to demonstrate the existence of this property.

Porous bodies present, in a very small space, a considerable amount of internal surface; the gases which penetrate into these substances lose their repulsive force, and accumulate in them as though by the influence of an extremely energetic attractive force. The phenomenon of porous bodies may be compared to that of capillarity; and just as the elevation of water in a tube may serve to show the existence of attractions between liquids and glass, the absorption of gases by charcoal is a proof of the attraction which a solid, isolated, and continuous surface may exert upon gases.

After ascertaining and measuring the absorption of gases by various porous bodies, De Saussure called the attention of chemists to an important fact, namely, that he had proved the gases condensed in charcoal produced abnormal chemical actions; since that time Döbereiner discovered spongy platinum: these combinations, anticipated by De Saussure, became more evident; but it was seen that they were preceded by a condensation of the gases, and, in fact, were the consequence of this; they consequently serve to prove it.

As soon as the discovery of Döbereiner was announced, Thenard and Dulong repeated his experiments with some variations. They ascertained that the properties of spongy platinum were possessed by porous bodies; they found them to exist in thin leaves of all the metals, and even in pounded glass or porcelain. Now if these combinations be the consequence of condensation, it must be admitted that this condensation takes place upon the metallic leaves and on the fragments of glass.

To these various experiments we must add the leading fact announced by M. Pouillet,—the absorption of oxygen in a platinum thermometer, and the condensation of the vapor of water by glass.

Moreover, this general idea admitted by geometricians, has often constituted the study of physicists, who, not hoping to prove it directly, have

*From the Lond., Edinb., and Dublin Philosoph. Magazine, August, 1853.

sought to verify it by indirect but very precise experiments. M. Arago proposed to cause the interference of two rays of light passing through the air, the one at a certain distance from, the other in contact with, a solid surface; he has recently returned to the same question, making use of the oscillations of a magnetized needle.

There exist, therefore, indirect proofs, which however to us appear conclusive, of the condensation of gases by solid surfaces; thus it was with nearly a certainty of success that we undertook the following experiments.

We filled glass vessels, which had been carefully measured, with pulverized solid substances; we ascertained the densities of the powders and the quantities contained in the vessels, and we had all the elements necessary for calculating the space left free.

Thus arranged, the vessels were connected with a good air pump and with a manometer with two branches; one of the two branches was open to the air; it allowed the pressures to be ascertained; the other was closed and communicated with the vessel by a tube and stop-cock; it served to measure a constant volume of gas, which was then driven into the vessel by causing the mercury to rise. At each introduction of gas the pressure increased by a quantity which was measured, and which could be calculated by Mariotte's law; the results of the experiment and of calculation were compared.

In this manner we have operated upon very various substances,—Fontainbleau sand, pounded glass of different degrees of fineness, and metallic filings and oxides. We have always found that the pressure observed was less than that calculated; we have therefore concluded that the gases were absorbed by the solid substances.

These absorptions present great analogy with those manifested by porous bodies; they are not produced instantaneously, but continue during several hours, only attaining their limit after a period which may be prolonged at pleasure; they vary in intensity according to the nature of the gas employed, being weak with hydrogen, stronger with atmospheric air, and very considerable with carbonic acid. We shall give their measure by the following results, obtained with pounded glass, washed and dried; the free space was 590 cubic centimetres, in which a vacuum was produced, and the gas was then allowed to fill it under the atmospheric pressure; it absorbed—

Carbonic acid.	Air.	Hydrogen.
645	602	595

We are convinced, moreover, that the preceding results are too low, and that it is impossible to measure exactly the quantities of gas contained in such spaces. When a vacuum is produced in them, the equilibrium of pressure is evidently re-established very slowly; the air-pump must be worked several hours to obtain a vacuum within 1 millimetre; and besides this, pressure does not remain constant, it gradually increases, and the action of the machine must be recommenced without ever being able to attain the maximum vacuum which it is capable of producing. The condensation obtained is the more energetic according to the goodness of the vacuum produced; but it is necessary to remember that its exact measure is never obtained.

Carbonic acid manifests these properties very energetically; when the powder with which the glass vessel is filled, whatever may be its nature, is exposed to this gas for the first time, it absorbs it rapidly, but on a second operation it has partially lost this property. The vessel already mentioned received, after evacuation, successive equal charges of this gas; the increase of pressure which they produced were measured, and by calculating the volume of the vessel by Mariotte's law, there were found—

721 cub. cent. 636 cub. cent. 629 cub. cent. 627 cub. cent. 622 cub. cent.

After these experiments a vacuum of the same degree was again produced, and the same successive introductions of gas being effected, gave—

644 cub. cent. 630 cub. cent. 621 cub. cent. 620 cub. cent. 616 cub. cent.

From these results we must conclude,—1, that the absorption takes place with the more energy in proportion as the original pressure is weaker; 2, that after having once absorbed a gas, the solid substance retains a considerable portion of it, of which it cannot be deprived, and which causes a proportionable diminution in its power of condensation.

These experiments require particular care, and can only be reproduced with very accurate apparatus; we will, however, describe one which any one may repeat without difficulty, and which will exhibit our results in a conclusive manner.

A fine powder (pounded glass or oxide of zinc) is mixed in a mortar with water which has been deprived of air, so as to form a clear paste without any bubbles of gas; this is poured into a flask with a long neck until it fills two-thirds of the bulb. After a short time the solid substance is deposited with a layer of water above it. A vacuum is then produced in the flask; at the first strokes of the piston the water rises, increases in volume so as to fill the flask, but no bubble of air makes its appearance; and if the cock of the air-pump be suddenly opened, the pressure is reproduced, and the fluid returns to its original volume with a rapidity which shakes the flask, and a sound like that of the water hammer. If the experiment be prolonged, and the vacuum completely formed, noticeable quantities of bubbles are produced.—*Comptes Rendus*, June 6, 1853, p. 994.

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*New Application of Photography—Daguerreotypes on Wood.**

Mr. R. Langton, wood engraver and draftsman, of Manchester, has produced some very successful and beautiful specimens of photography, taken by himself, on blocks of box-wood. This photograph, so taken, is quite ready for the application of the wood engraver's burin. It is impossible to say how greatly this will advance the process of wood engraving, especially by saving all the preliminary labor of the draftsman; which, in many cases, constitutes the chief element in both the time and the cost attendant on the production of wood-engravings of a high class. Even in many of the lower branches of the art, the new application of sun-drawing will be an invaluable auxiliary. For instance, it is an ex-

* From the London Civil Engineer and Architect's Journal, September, 1853.

ceedingly difficult matter to get accurate drawings of machinery, in perspective; mechanical draftsmen only represent it in plane; and artists are generally found extremely reluctant to employ a large amount of time so unprofitably as the drawing of a complicated machine in perspective demands. These photographs can now in a few seconds accomplish what it would require hours for the artist to effect; and in point of accuracy the instrument must ever have the preference. But great as will eventually be the boon which this new application of photography will confer on the practical art of wood engraving, it may be made more extensively valuable, as a cheap form of producing pictorial objects. By Mr. Langton's process portraits, landscapes, &c., could be produced on any smooth piece of wood, duly prepared; and thus even wooden snuff boxes, hand screens, &c., may be decorated with portraits or scenes from nature, or copies of works of art, at a cost much less than daguerreotypes on metal plates. Indeed, it is difficult to say where the applications and uses of this new process may not extend. The inventor does not limit his invention to its use in wood engraving, but claims for it an equally useful and valuable application in other directions, in connexion with practical art.

Weights and Measures. By W. B. Jack.*

The following remarks are submitted to us in reference to a paper read before the Society of Arts, on the 23d of February last, and reported in the *Athenæum* of three days' later date.—I wish [says the writer,] to mention, that the paper was of a very unpretending character, and was prepared by me in the spring of 1852, with the intention of being read before a very small association of gentlemen in this place. In the autumn of the same year, I perceived that the Society of Arts had formed a Colonial Committee, one of whose objects, as stated in an enclosure sent through the Colonial Office to the Lieutenant Governor of New Brunswick, is—"To make a comparison of coins, weights, and measures, as used in the Colonies, and to receive and discuss propositions for giving them uniformity." Having, therefore, the paper lying by me, I forwarded it, just as it was—thinking that one part of it might furnish some such information as was desired; but not at all supposing that it would be deemed worth reading before a formal meeting of such a body as the Society of Arts. I beg, however, to call your attention to a point which I regard as somewhat important, and deserving of further consideration; namely, the way in which I proposed to reduce our confused, perplexing, and incongruous tables of weights to one which would, nevertheless, include all the most essential denominations in each, and moreover be framed in a great measure according to the decimal scale. In Troy weight it is necessary to preserve the *grain*, or some simple multiple, or submultiple of it. The other denominations are much less frequently used, and can all be readily reduced to grains when needed. In Avoirdupois weight the pound cannot be dispensed with; and although the ounce is employed to a considerable extent in the retail trade, yet it is desirable

* From the London Athenæum, June, 1853.

on several accounts to abolish it; and to accomplish this would, I conceive, be neither very difficult nor hazardous. The following is the Decimal scale suggested:—

Grains.	Millozes.	Centoze.							
5 =	10 =	1 =	Secoze.						
5 1/2 =	100 =	10 =	1 =	Oze.					
500 =	1000 =	100 =	10 =	1 =	Pound.				
7000 =	14000 =	1400 =	140 =	14 =	1 =	Stone.			
98000 =	196000 =	19600 =	1960 =	196 =	14 =	1 =	Sekone.		
980000 =	1960000 =	196000 =	19600 =	1960 =	140 =	10 =	1	Hectone.	
9800000 =	19600000 =	1960000 =	196000 =	19600 =	1400 =	100 =	10 =	1	Kilone.
98000000 =	196000000 =	19600000 =	1960000 =	196000 =	14000 =	1000 =	100 =	10 =	1

In the table of long measure I have ventured to propose the *foot* instead of the *yard*, as recommended by the Commissioners in their Report of 1841, for the basis from which to proceed decimally,—inasmuch as a decimal multiple and submultiple of the former are in common use, more especially among engineers. In this colony the measures of capacity are in a most unsatisfactory state; but a Bill for regulating all weights and measures has been proposed for the consideration of the Provincial Legislature during their present session, and I think it will receive their sanction. My own prepossessions are strongly in favor of adopting the imperial measures; but I am obliged, reluctantly, to confess that it would be injudicious to attempt their introduction here, principally for the following reasons:—1. Because the old measures are retained in all the British colonies in North America, and in the West Indies, as also in the neighboring States of the Union.—2. Because all the liquid measures now in universal use throughout the colony would have to be replaced by the imperial, at no inconsiderable expense; and many old customs and habits would consequently be interfered with. The needless and mischievous distinction between liquid and dry capacity will be rendered less objectionable by a clause in the Bill, which orders that all grains, roots, &c., heretofore sold by stricken or heaped measure, shall henceforth be sold by weight, and that so many pounds of such articles, specially named, shall be deemed and taken to be a bushel. In this out-of-the-way corner of the world, the *Athenæum* has, for many years, been a solace to me, as one of the means of keeping up my connexion and acquaintance with the great world without.

Chinese Magic Mirrors.

To the Editor of the Franklin Journal.

In the October number of your *Journal*, I noticed an article translated from the French, ascribing the discovery of the cause of the phenomenon of the Magic Mirror to MM. Biot and Arago, of the French Academy. By referring to vol. xv. of the 3d series of your *Journal*, p. 52, you will find I gave precisely the same solution as that of the learned Academicians as early as 1847. Yours, respectfully,

J. J. Greenough, No. 6, Wall st., N. York.

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Our esteemed correspondent must pardon us, but the explanation to which he refers us is by no means the same as that of the French Acade-

micians. He explains the phenomenon by "inequality of polish;" that is, that the surface on the figures is either more or less bright than the rest; but this will not account for the phenomena, because, according to the distance of the screen from the mirror, the figure is either lighter or darker than the ground.

The explanation of Messrs. Arago and Biot is, that the *curvature of the surface* is altered by the greater or less rigidity of the figures, and thus throw the focus of these parts at a greater or less distance from the mirror than that belonging to the general figure. This accounts for all the phenomena. EDITOR.

Remarks on the Structural Conditions of Iron. By T. R. V. FUCHS.*

The difference in physical characters presented by the several kinds of iron is generally attributed to the presence of a variety of substances, among which carbon is considered the most important. It is contained in all kinds of iron, almost always accompanied by silicon, which perhaps exercises the same influence. Raw iron contains the largest quantity of carbon, bar iron the least, and steel is in some sort intermediate between the two; but the quantity of carbon does not in any case bear a constant proportion to the iron, nor are these three kinds of iron separated from each other by any definite limits. These two facts are sufficient to show that the carbon cannot be in a state of very intimate combination with the iron, and there are no sufficient grounds for assuming that the different conditions of this metal are determined solely by the quantities of carbon contained in it. The numerous, and in many respects valuable, analyses of iron have served only to prove the truth of the above remark. Upon the gratuitous assumption that the varying per centage of carbon is the cause of the differences in the character of iron, attention has been too exclusively devoted to this point, while another, and perhaps more essential one, the crystalline structure, has been overlooked.

Fuchs expresses his conviction that iron is a dimorphous substance; that there are, in fact, two species (varieties) of iron,—the tesseral and the rhombohedral. He considers it as proved that malleable iron belongs to the tesseral system; and if any doubt still exists, it may be inferred from analogy that such is the case, inasmuch as all other malleable metals possess crystalline forms belonging to this system.

The crystalline form of raw iron has not been ascertained with so much certainty, but Fuchs considers it highly probable that it belongs to the rhombohedral system, because it comes within the class of perfectly brittle metals, the crystalline forms of which, as far as we are acquainted with them, are rhombohedral.

But the difference between malleable and cast iron does not consist merely in the crystalline structure, which may be open to doubt, but likewise in their physical characters, and to some extent in their chemical behavior; for instance, the cohesion, hardness, resistance to fracture, fusibility, oxidizability, solubility in acids, &c. He is of opinion that these circumstances alone would justify the inference that there is a spe-

* From the London Repertory of Patent Inventions, Nov. 1853.

cific difference between malleable and cast iron, which he compares with those presented by the modifications of sulphur, phosphorus, arsenious acid, by glass and Reaumur's porcelain.

Finally, with regard to steel, Fuchs is of opinion that it is an alloy of tesseral and rhombohedral iron. The per centage of carbon which it contains varies from 0·625 (Gay-Lussac) to 1·9 (Karsten). It cannot therefore be regarded as a definite and constant compound. It differs from other alloys in the circumstance that its characters may suffer considerable alteration without an accompanying addition or loss of substance, as in the hardening and softening of steel, changes which Fuchs supposes to be the result of an internal and alternating metamorphosis, by which the relative proportion of the two species of iron is altered. Thus, according to his views, in hardened steel the rhombohedral preponderates over the tesseral iron, and the reverse in soft steel. Very hard steel would, therefore, from the very small proportion of tesseral iron, approximate closely to cast iron; and this conjecture is favored by the low specific gravity of hardened steel. By the process of tempering, the proportion of tesseral iron in steel would increase with the temperature. The two kinds of iron in steel may be regarded as in a state of constant mutual tension, which may perhaps be the reason why steel retains permanently communicated magnetism, while malleable iron does not.

An experiment of Schafhäutl's* would appear to favour the above views. He submitted a piece of a razor-blade to the action of tolerably strong hydrochloric acid for several days, at the end of which time it was found to have been very unequally attacked. When washed, dried, and broken in a mortar, it furnished fragments, some of which could be powdered, while others were malleable.

With regard to the important and much-discussed question of the alteration of malleable iron when exposed to continuous vibration, concussion, or torsion, in consequence of which it requires a granular fracture, Fuchs admits that such an alteration takes place even in the best worked metal, but does not altogether agree with the explanation usually offered for it, viz., the gradual assumption of a crystalline texture; and is of opinion that it consists in the passage of the iron from a fibrous crystalline state to a granular crystalline state, a change in the aggregation, not an essential metamorphosis. When iron passes from the fibrous into the granular texture, the cohesion of the molecules is lessened; and by their aggregation into rounded groups a heap of distinct particles is produced, which may be compared with what mineralogists call granular minerals. The continuity of the mass is thus to some extent destroyed, inasmuch as these granular particles only adhere together more or less, and consequently the greater the size and number of these particles the greater is the diminution in tenacity. According to the statement of Kohn, the original condition of iron thus altered cannot be restored by heating to redness and forging, but only by exposure to a welding heat; and Fuchs considers this a sufficient proof that this alteration of iron consists in a breaking up of the continuity of the mass. The restoration of this continuity requires that the granular iron should, by exposure to a weld-

*Prechtl's *Technologischer Encyclopedie, Abhandlung uber den Stahl*, vol. xv., p. 377.

ing heat, be rendered amorphous, when the cohesive force again becomes active, a condition which in the case of most other bodies obtains only when they are liquid.—*Schweizerisches Gewerbeblatt, September*, 1852.

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*On the Economy by the use of Different Vapors in the Steam Engine.**

Dr. Apjohn made a communication, the object of which was to demonstrate the fallacy of the doctrine, that in order to produce a given volume of vapor, having a given elastic force, the same quantity of fuel must be consumed, irrespective of the nature of the liquids employed.

"It has been frequently proposed to substitute the vapor of some volatile liquid, such as alcohol or ether, for that of water in the steam engine, under the idea that by so doing fuel would be economized; and the proposal appears *primâ facie* plausible, seeing that the boiling points are not only lower than that of water, but that the same is true of their specific heats, and of the latent heats of their vapors. This idea would seem to have struck at different times the minds of different persons, and the Rev. Mr. Cartwright, a gentleman of great mechanical genius, and celebrated for his mechanical inventions, actually devised a most ingenious form of steam engine,† in which the piston was to be moved by the vapor of alcohol.

"Mr. Ainger, in a notice brought by him before the Royal Institution, London, in February, 1830, on the Economy of the Steam Engine, would seem to be the first person who publicly dissented from such views; and he has certainly the merit of having shown the insufficiency of the data generally used by those who, previous to his time, calculated that the substitution of more volatile liquids for water would lead to a considerable saving of fuel. The conclusion, however, at which he arrives, that, leaving the original cost of the liquids out of consideration, water would be as economical a liquid as alcohol or ether, I believe to be quite erroneous; and as the question at issue is one of some practical importance, I shall proceed to state succinctly the method of calculation which I have employed in discussing it, and the precise results at which I have arrived.

"As the vapors of different liquids have at their respective boiling points the same elastic force, equal volumes of them will produce equal mechanical effects. In order, therefore, to the solution of the question under consideration, it will only be necessary to calculate the weights of the different liquids, water included, which give equal volumes of vapors, and to determine the quantities of caloric necessary for the conversion of them into vapor.

"Now as the volume of a vapor, like that of any other form of matter, is represented by its weight or mass, divided by its specific gravity, if we put $\frac{x}{s'} = \frac{1}{s}$, x being the weight of any vapor, whose specific gravity is s', and s the specific gravity of the vapor of water, we will get $x = \frac{s'}{s}$, that is, the weight of any liquid which, at its boiling point, gives a vol-

* From the Proceedings of the Royal Irish Academy, 1851—2.
† See Philosophical Magazine, vol. 1.

ume of vapor equal to that given by a weight of water represented by unity at its boiling point, is got by dividing the specific gravity of the vapor by that of steam. But the specific gravities to be used in this computation are not those usually given in books, each of which is referred to a different unit, viz., air at the same temperature, and under the same pressure as the vapor, but the specific gravities of the vapors at the respective boiling points of the several liquids, compared to the standard unit, viz., air at 60°, and under a pressure of 30°. In the following tables, the former specific gravities are found in the second, and the others in the third column, the latter being in each case got by multiplying the former by $\frac{518}{458+t}$, t being the boiling point of the liquid which yields the vapor. In the fourth column we have the weights, which would give equal volumes of vapors, calculated by the expression $x = \frac{s'}{s}$ already given, the values of s and s' being taken from the third column.

1.	2. Specific Gravity referred to air at Boiling points.	3. Specific gravity at Boiling points referred to air at 60°.	4. Weights, giving equal volumes of vapor.
Water, .	·622	·480	1·000
Wood Spirit,	1·120	·950	1·979
Alcohol, .	1·613	1·322	2·754
Ether, .	2·586	2·397	4·993

"It is now easy to assign the quantities of caloric necessary to produce an equal volume of the vapor of each liquid at their respective boiling points, for these will obviously be represented by the expression $m\,c\,\{(t-50)+l\}$, m being for each liquid its number in column 4, c its specific heat, t its boiling point, and l the latent heat of its vapor at the temperature of ebullition. When, with the aid of the annexed table,—

	Boiling Points.	Specific Heats.	Latent Heats.
Water, .	212°	1·00	961·8
Wood Spirit,	151·7	·67	475·2
Alcohol, .	172·4	·64	374·4
Ether,	100·4	·50	163·8

which exhibits the specific and latent heats on which most reliance can be placed, the numerical calculation is made, the following are the results:—

Water, .	1129	1·000
Wood Spirit, .	764·8	·676
Alcohol, .	875·5	·775
Ether, .	534·7	·473

"The mere inspection of these numbers is sufficient to show that Mr. Ainger is in error, or that by substituting for water, wood spirit, alcohol, or ether, the same moving force will be obtained, and with a great saving of fuel. With wood spirit, about two-thirds, with alcohol, about three-fourths, and with ether, somewhat less than half the caloric required by water will suffice.

"To the use, however, of such liquids there are obvious objections. Their cost is considerable compared to that of water, and as they evolve at atmospheric temperatures vapors of a considerable elastic force, they

will, from imperfect condensation, resist the motion of the piston, and thus give rise to an appreciable loss of power. But, notwithstanding this practical difficulty, which, by the way, is not in the cases of alcohol and wood spirit one of a formidable nature, the theoretic conclusion is no less certain, that equal volumes of the vapors of different liquids, formed at their respective boiling points under the pressure of a single atmosphere, *do not* require for their production equal quantities of caloric."

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, November 17, 1853.

Samuel V. Merrick, President, in the chair.
Thomas Fletcher, Vice President.
John F. Frazer, Treasurer.
William D. Parrish, Recording Secretary, P. T.

The minutes of the last meeting were read and approved.

Letters were read from L'Ecole Nationale des Mines, Paris; The Royal Geographical Society, London; and John Marston, Esq., U. S. Navy.

Donations to the Library were received from L'Ecole Nationale des Mines, and La Societie d'Encouragement pour l'Industrie Nationale, Paris; The Society of Arts, The Institute of Actuaries, The Royal Geographical Society, London, and the Royal Polytechnic Society, Falmouth, England; Prof. A. D. Bache, Coast Survey Office, Judge Mason, Commissioner of Patents, and William Chauvenet, Esq., D. C.; The Legislature of the State of Pennsylvania; The Councils of the City of Philadelphia; Dr. J Kirkland, Cleveland, Ohio; John Marston, Esq., U. S. Navy, and Charles Hartshorne Esq., Philadelphia.

Donations to the Cabinets, from Messrs. Merrick and Sons, Wm. W. Fleming Esq., Philadelphia.

The Periodicals received in exchange for the Journal of the Institute were laid on the table.

The Board of Managers and Standing Committees reported their minutes.

The Committee on Exhibitions presented so much of their report on the late Exhibition, as refers to the articles manufactured by the Hamilton Woolen Co., Southbridge, Mass., deposited by Messrs. H. Farnum & Co., and recommend the award to them of a *Gold Medal* for their superior Delaines and Cashmeres.

On motion, the medal was awarded in accordance with the report.

Resignations of membership in the Institute (54) were read and accepted.

New candidates for membership in the Institute (134) were proposed, and the candidates (11) proposed at the last meeting were duly elected.

Mr. Fairman Rogers exhibited and described the Bourdon barometer, an instrument upon the same principle as the pressure gauge by the same inventor. It consists of a thin, flat, metallic tube, bent into the form of a circle, the two ends nearly meeting, hung by a point in the middle of its

length, so that the equal motion of its ends will compensate for changes of temperature.

The two ends are attached to a lever having at one extremity a circular rack, which acts upon a pinion on the axis of the index hand. The communication between the air inside the tube and the atmosphere being entirely cut off, the varying barometric pressure of the atmosphere will cause a contraction or expansion of the tube, which is registered by the index hand.

Mr. Rogers also exhibited a triangle and rule arranged for drawing parallel lines at any given distance apart. A neat little instrument for the hatched lines in plans, or machine drafting. Also, a small instrument termed a map-meter, consisting of a circular metal disk three-quarters of an inch in diameter, with a chamfered milled edge, which moves as a nut on a screw three-quarters of an inch long, held between two arms of the handle of the instrument. It is designed to measure any sinuous line upon a map, such as a road or river. The disk is screwed along upon its axis until it jams against one of the cheeks of the fork which holds it; the instrument is then held upright with the lowest point of the circumference of the disk upon the end of the road to be measured, and moved over the line, the disk moving along the axis, one thread for each revolution. When the end of the line is reached, the lowest point of the disk is placed upon the zero point of the scale of distances, and moved in the opposite direction until it jams against the side of the fork, having necessarily made an equal number of revolutions, and traversed the same distance on the scale as on the map.

G. W. Smith exhibited to the meeting the working drawings, consisting of elevations of the facade and flanks of a church, now in progress at the N. W. corner of Broad and Mulberry Streets, Philadelphia; S. B. Button, Esq., architect. The edifice is of brown stone in the Byzantine or Romanesque style, having four dissimilar towers at the angles; the one at the S. E. corner being capped by a lofty octagonal stone spire rising to the height of 226 feet from the ground; the arches in the building, string-courses, &c., being highly enriched with foliage and other reliefs, boldly and elaborately sculptured. It is the first instance in this style among the ecclesiastical edifices of this City, at least of any magnitude.

Mr. S., after commenting upon the various contrivances which have been adopted or proposed for the prevention of the bursting of water pipes by the sudden shock or check of the momentum of the water when in motion, and the causes of their failure, presented to the meeting a plan which he believed would be efficient, economical, and lasting; a small hollow sphere, or other box, containing in its cavity communicating with the pipe within the stop cock, a sphere or other suitable mass of vulcanized india rubber enclosed therein, will receive the shock from the water when suddenly stopped, and thus greatly exhaust its force, and thereby preserve the pipe from injury.

The following communication was written for the *Journal*, in 1845, but its publicaton having been accidentally omitted, was presented to the Institute at a former meeting; the omission is now herewith supplied.

"On the Perpetual Ventilation of the Great Pyramid of Egypt, by G. W. Smith.

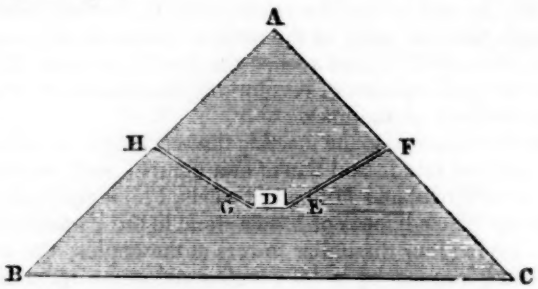
"This method of *Solar ventilation*, which has so recently been applied in

the United States is nevertheless the most ancient in existence; having been applied at least 4000 years ago in that most venerable monument of Egypt, the great pyramid of Cheops, (Khoufou or Suphis).

"In the first volume of Vyse on the pyramids of Gizeh, page 286, a description is given by Colonel Vyse of operations for removing the obstructions from two narrow apertures or tunnels, which ascend from the great chamber near the centre of the pyramid to the surface in an inclined direction.

"These had long been conjectured to be ventilators, and when the rubbish had been removed from them, the previous conjectures proved to be correct. The suffocating mephitic air of this, the King's chamber, was immediately changed by a rush of pure air from without.

"The manner by which these air channels acted when the present entrance passages were closed, has not hitherto been explained, Mr. G. W. S. stated, by any writer on these monuments. As the mode of action is extremely simple and efficient, and the very durable apparatus entirely self-acting, requiring no attention whatever, being moreover in as perfect a condition as on the remote day when it was finished, 120 generations ago, it deserves our attention. An inspection of the diagram will exhibit the plan at a glance.



A B C, The pyramid in section. The closed passages are not represented.
D, The King's chamber.
E F, The north air channel.
G H, The south air channel, "which being more heated from the sun's rays striking on the south side of the mass A B, the air will be heated, and thus rarified will rise in it by the pressure of the dense column in the northern or cooler side of the pyramid, day and night forever."

"During the process of building the chamber, and until the external casing of the pyramid was added, it cannot be doubted, that the action would be perfect; but even when cased, the joints would not be perfectly air tight, and therefore would permit some circulation of air.

"Mr. S. stated, that recently in this city, advantage had been taken of certain brick walls containing flues; the walls being heated by the sun to which they were exposed, rarified the air in the flues which communicated at their lower portions with the apartments to be ventilated, and the plan has been found, even with thin walls, quite effectual, and was strongly recommended for adoption in many places where it might be applicable.

COMMITTEE ON EXHIBITIONS.

Address delivered at the close of the Twenty-Third Exhibition of American Manufactures, held by the Franklin Institute of the State of Pennsylvania, for the promotion of the Mechanic Arts, from October 18th to November 3d, 1853. By GEORGE HARDING, Esq.

The Committee on Exhibitions have invited me to deliver the closing address this evening. Deeply sensible of the honor thus conferred, and feeling the warmest interest in the success of our Institute, I have ventured to accept their invitation. I fear that you will have reason to regret that their choice had not fallen upon one better fitted by age, occupation, and experience for the performance of this duty; or that a personal sense of unfitness had not, on this occasion, constrained me to decline.

With regard to the exhibition about to close, I need speak little. To tell you that it surpasses its predecessors, and has elicited the admiration of the community, is but to say that the mechanics of Philadelphia have displayed the fruits of one more year of labor and of genius; and that this has been appreciated by a discriminating public.

The promotion of the mechanic arts is the object for which this Institute was organized. Its agents in accomplishing that purpose are the stimulus of rivalry excited by annual exhibitions, and its provisions for systematic instruction in the application of science to the arts and manufactures. I have thought, therefore, that a sketch of the progress of the mechanic arts, as fostered, in times past, by these means, would be an appropriate, and, perhaps, not an uninteresting subject.

My principal aim in this will be to show that the present advancement of our arts and manufactures results from, and their future progress is dependant upon, the intimate union of Science with Art.

The world was nearly six thousand years old before philosophy assumed her true position and became the handmaid to the arts. From the time of Socrates down to the middle of the sixteenth century, philosophy despised and neglected art, and art pined and dwindled for want of her aid. Philosophy preferred rather to devote herself to vague and impracticable theories of moral perfection, to subtle and unmeaning disputations. When she did deign to study natural and physical objects, such study was regarded merely as a mental exercise or diversion.

It is curious to observe to what extent this aversion of philosophy from art was carried under the sway of the lofty intellects of Socrates, Plato, and Seneca. Plato considered geometry as degraded by being applied to any useful purpose. Archytas, who lived about four hundred years before Christ, constructed machines of great ingenuity and considerable power upon mathematical principles, and is even said to have made a mechanical pigeon which could fly. Plato remonstrated with his friend Archytas, telling him that he was degrading a noble intellectual exercise into a low craft, that the true office of geometry was to discipline the

mind. From that time all the mechanical arts were considered as unworthy the attention of a philosopher.*

Archimedes far exceeded all other men of ancient times in mechanical ingenuity. He was familiar with the doctrine of specific gravity, and practically applied it in detecting the fraud of King Hieros' jeweller, in debasing the crown. When Marcellus besieged Syracuse, Archimedes, from the walls of that city, raised out of the water and destroyed the hostile galleys, or hurled great stones into and sunk their ships; and by means of mirrors he so concentrated the rays of the sun as to burn the fleets of the enemy at a distance. So highly was this man esteemed for his mechanical construction, that, when Syracuse was taken and sacked, his house alone was ordered by Marcellus to be spared. And yet, such at that time was the disposition of philosophy towards the mechanic arts, that Archimedes expressed himself ashamed of these great works; and it was with difficulty that he could be persuaded to divert his mind to them, from mere speculations and abstractions. He regarded his great mechanical works as trifles, with which a mathematician was permitted only to amuse himself.†

A distinguished writer, in the time of Cicero, once ventured to enumerate among the humble blessings which mankind owed to philosophy, the discovery of the principle of the arch, and the introduction of the use of metals. Seneca regarded this as an *insult* to philosophy, repelled it, and indignantly replied to him that philosophy had nothing to do with teaching men to rear arched roofs over their heads; the true philosopher does not care whether he has an arched roof or any other roof; to impute to a philosopher any share in the invention of a plough, a ship, or a mill, is an insult.‡

Such being the state of ancient philosophy, it is not to be wondered at that, for nearly six thousand years, the mechanic arts, despised and neglected, made but small advances. While Greece and Rome, in poetry, eloquence, statuary, and painting, attained to a degree of perfection unsurpassed in modern times, their mechanic arts remained almost stationary. Homer and Virgil are models for the poets of the present day. Men still revert to the glorious age of Athenian eloquence. The fame of Phidias, the sculptor, and of Apelles, the painter, have survived the shock of time which has destroyed the canvass and crumbled the marble. But the natural philosophy of Aristotle and Plato vanished before the light of modern science as suddenly as their moral theories did before the blaze of Christianity.

The human mind was misled by this false doctrine of philosophy until the close of the 16th century. It was then forever overthrown and demolished by Bacon. He taught a new doctrine. He exhorted men to consider the true end of knowledge, and not to seek it for the gratification of their minds, or for disputation, or that they may despise others, or for emolument, or for fame or power, or such *low objects;* but for its *intrinsic merits* and the *purposes of life*. "The greatest error of all the rest," he said, "is the mistaking or misplacing the last or furthest end of knowledge, for men have entered into a desire of learning and knowledge; sometimes,

* Plutarch's Life of Marcellus.
† Plutarch's Life of Archimedes and Marcellus.
‡ Seneca's Epistles.

upon a natural curiosity and inquisitive appetite; sometimes, for ornament and reputation; sometimes, for victory of art and contradiction; seldom, sincerely to give a true account of their gift of reason to the benefit and use of men. * * * * But it is that which will, indeed, dignify and exalt knowledge, if contemplation and action may be more nearly and straitly conjoined and united together."*

From Bacon, men first learned that science and the arts should walk hand in hand together, and since his day they have so journeyed. The good of mankind, thenceforth, became the aim of Philosophy. Deep was the root which the new doctrine took in the minds of men, and from it has grown the tree of modern science.

Bacon died in 1626. The tumults and troubles of the reign of Charles I.,'the revolution of 1642, and the disorders which ensued, for a time, delayed the progress of science; but immediately after the restoration, in 1660, it began to advance with rapid strides.

About the year 1660, the Royal Society commenced its operations. This Society was originally founded directly upon the motto and the philosophy of Bacon.† The earliest records we have of its sessions date in the year 1664, and these show that much attention was given by it to the mechanic arts. During the very first year of its existence, one member was directed to bring in an account of iron, from the ore to the bar; another, to inquire into the manufacture of hats; another, into the making of lead; a fourth, delivered a full and elaborate report on the history of the manufacture of cloth, as then in use. Tracts were read on the art of marbling paper, and on the refining of gold. Much of the time of the Society, however, was devoted to researches in agriculture and medicine, which had been also neglected under the old philosophy.

The barbarous state in which science had been left by the Alchemists, greatly embarrassed their early investigations. Many fables and falsehoods had been bound up with a little true knowledge, and a large portion of their time was occupied in investigating subjects which now excite our ridicule when mentioned. Thus, their recorded transactions inform us that on one occasion a member was ordered to provide some fresh hazel-sticks to try the experiment vulgarly called the divining-rod. Another member was subsequently ordered to bring his box of little animals called the death-watch; and at the next meeting, there were accordingly produced before the academy two of these insects for inspection and experiment.

On the 5th of June, the Duke of Buckingham was enrolled a member, and contributed a piece of unicorn's horn. The Society proceeded to try an experiment with it, recorded in the minutes as follows:—"A circle was made with powder of unicorn's horn, and a spider set in the middle of it, but it immediately ran out. The trial being repeated several times, the spider once made some stay on the powder."‡

* Bacon.—"Advancement of Learning," 174.

† The Royal Society was an attempt to reduce to practice Bacon's fiction of the New Atlantis. The influence of Bacon was not limited to England—it extended to France, and eventually throughout the Continent. In 1621 Bacon corresponded with Beranzon, an eminent professor in Savoy, in reference to his project for scientific investigation and discovery. And Des Cartes, who was one of the original founders of the French Association, the basis of the present National Institute of France, shows by his letters to Mersenne, in 1642, that he was familiar with, and entertained the most profound respect for the works of Bacon.

‡ Birch's History of the Royal Society, pp. 26, 84, 270, 333.

The instrumental collection of the Society appears, during the first year, to have been limited, showing the low state of experimental science at that day. An air-pump, presented by Boyle, a rude microscope, and a loadstone, seem to have comprised their collection. With these, however, they conducted a great variety of experiments. Every thing that was deemed worthy of investigation was either placed under the air-pump or submitted to the microscope. The academy were, nevertheless, proud of their instruments; their experiments were tried with great solemnity, and foreign ambassadors and princes were taken with pomp to see them.*

Two mechanical inventions were before the Academy that year. One was the scheme of an improved engine for carriage, of such a one as goes by one wheel and is drawn by one horse. The society ordered a model made of it, and at the next meeting was produced the modern wheel-barrow made in pasteboard. The second invention was a bow-gun for shooting whales, subsequently abandoned. During the same year, information was received as to the state of one of the arts in the American colonies, then in their infancy. The process reported upon has probably been lost in the lapse of years; it was the art of killing rattlesnakes in Virginia. The outline of this process is thus recorded: "Some leaves of the wild penny-royal were bruised, and these were tied in the cleft of a long stick; this was then held to the nose of the rattlesnake, who, by turning and wriggling, labored as much as he could to avoid it; but he was killed with it in less than half an hour; and, as was supposed, by the scent thereof."†

At the same meetings at which these, to us, apparently so trivial subjects were discussed, investigations were presented which resulted in our present form of barometer, in a portion of our present theory of heat and cold, and in improved modes of making lenses. This, too, it will be remembered, was only six years before the immortal Newton, in the 23d year of his age, communicated to the Society his theory of light, and commenced that brilliant career which during sixty years shed such lustre upon their proceedings.

From our present height of science, we can look back and behold these pioneers clearing the plain below, now gradually surmounting the obstacles in their course, now wandering backwards for a space, oft times delayed by the accumulated rubbish of old philosophy, but still steadily advancing, having truth—real, substantial, beneficial truth—for their object, and the omnipotent philosophy of induction for their guiding strength; until in the lapse of time we behold their Gregory, Davy, Wollaston, Cavendish, Brewster, Daniels, Farraday, and their compeers, fixing the utmost verge of earth for their bounds; and Newton and Herschel, the highest heavens for their resting place.

The Royal Society subsequently devoted its attention more especially

* Macaulay tells us, that Chief Justice Hale and Lord-keeper Guilford stole a portion of time from their judicial labors, to write treatises on hydrostatics. King Charles spent much time in his laboratory at Whitehall. "It was almost necessary to the character of a fine gentleman to have something to say about air-pumps and telescopes; and even fine ladies, now and then, thought it becoming to affect a taste for science, went in coaches and six to visit the Gresham curiosities, and broke forth into cries of delight at finding that a magnet really attracted a needle, and that a microscope really made a fly look as large as a sparrow." Macaulay, Hist. of England, p. 380. Pepey's Diary, May 30, 1667.

† Transactions Royal Society, No 3, p. 43.

to the advancement of science, as distinguished, from its application to the useful arts, and there sprung up in London, about a hundred years ago, another society, formed for the purpose of effecting a more direct union of science and art. That society was arranged much upon the same general plan as the Franklin Institute. It had its library, collections of models and machines, distributed premiums for inventions, improvements, and superior workmanship; and for nearly seventy years has published an annual volume of transactions. It was the first society which thus brought home to the practical mechanic the means of intellectual improvement in his profession. By its agency the position of mechanics was elevated in England, and the arts greatly advanced. This society arose at a fortunate era in the history of the Mechanic Arts—the era of the steam engine. At that time James Watt was fifteen years old; fourteen years afterwards he gave to the world his immortal discovery.

And here let me remind you how far he thus contributed, beyond all other men, to the lasting comfort, happiness and glory of his race. In 1769 he converted a simple fire-pump into an engine of boundless power. Nearly a hundred years have elapsed since then, and yet it remains, substantially, unchanged. For eighty years that engine has toiled with the strength of millions of horses, for all men, in every land. Above the wreck of electro-magnetic and hot-air engines, the fame of James Watt, in undiminished splendor, towers proudly eminent. To his genius the hundreds of thousands of our fellow-men in the manufactories of Great Britain, France, and Germany, owe their daily bread; on every navigable river, lake, and sea, on the mountain top and in the deep mine, his engine is working out man's purposes. It has caused towns and cities to spring up and flourish on the barren rocks of New England; it melts, pounds, and rolls the iron of Pennsylvania, and gladdens our ears with the hum of a hundred workshops. It has given to the South a world-wide and insatiable market for its staple; it has filled the Valley of the Mississippi with vigorous life and abundant wealth, carrying its harvests to the East, and bringing back in return the products of manufacture and the rich spoils of commerce. The iron-road, which is but its pathway when it moves upon the earth, binds together the people of our thirty-one States by a tie as strong as our Federal Constitution. To that engine the works of Arkwright, Fulton, Fitch, and Whitney owe the exigency which brought them forth, and the energy which gave them life. Itself the greatest of inventions, it has called forth the highest ingenuity in others. Itself the strongest of mechanical powers, it has rendered available the greatest human strength. If Bacon gave to science the word of truth, Watt gave to art the arm of power.

Fidelity to my subject would require me to trace the organization of associations similar to the Royal Academy throughout Europe; to narrate how the great Colbert, at the instigation of Louis XIV., founded in 1666 the Academy of France; that Society which, in the words of David Brewster, "has stood unshaken and active amid all the revolutions and convulsions which so long agitated that noble, but distracted country; a common centre of affection, to which antagonistic opinions, rival interests, and dissevered hearts have peacefully converged." It would further be my duty to show how, in rapid succession, there sprung up at St. Peters-

burg, at Stockholm, at Berlin, Edinburgh, Dublin, Copenhagen, Brussels, and Turin, similar academic bodies, bright towers of science, whose light illumined the whole continent, and was, in time, reflected back by many stately halls reared to industrial art. Passing thence to our own country, and later days, I should call to mind the origin of the American Philosophical Society, and the establishment of our own Institute in 1824; her early struggles, her subsequent prosperity, and how, for thirty years, she has labored strenuously to unite the interests of the professor and the mechanic. The distinguished success achieved by many of her members—by many, whose presence here forbids my further speaking of them—her reported experiments on water wheels, on boiler explosions, on the strength of metals, and others in high repute throughout the scientific world, her large library, her crowded exhibitions, and her able Journal, testify how faithfully she has carried out the purposes for which she was organized.

I fear, however, that this detail would become tedious to you; the encouragement of mechanic arts through the medium of Exhibitions, demands, moreover, a brief attention.

The Marquis d'Aveze was appointed Commissioner of Royal Manufactories in France, in 1797. He found that two years of neglect had reduced the workmen almost to starvation, and he then conceived the idea of converting the Chateau of St. Cloud into a bazaar, for the exhibition and disposal by lottery of the tapestry, china, and carpets, unsold and stored in the warehouses of the principal manufactories. A decree of the Directory, in the same year, however, banished him along with other nobles from France. He was permitted to return in the succeeding year, and then carried out his original plan at the Maison d'Orsay. The project was eminently successful, and attracted the notice of the French Government. That government then erected a Temple of Industry, which was filled with the most beautiful manufactured objects of France. On that occasion the practice of determining the relative merit of contributors and of distributing prizes by committees, originated. This exhibition was so successful that it was determined to repeat it annually.

The troubles of the French nation delayed its repetition until 1801; the third was held in 1802; the fourth in 1806. The wars of France delayed the fifth until 1819. Six others succeeded at intervals of five years, the eleventh exhibition having taken place in 1849, in the Champs Elysée. To their popularity is the origin of the Society of Encouragement to be traced—a society similar to our own, founded about 1804, and which has greatly promoted French art and manufacture.*

These exhibitions, it will be remembered, were all carried on by the government. The attention of the "British Society of Arts," was directed to the importance of the subject, about 1847, when their first public display was made. The Franklin Institute gave its first exposition of American manufactures in 1824.

Thus, it will be seen that this Institute is entitled to the merit of being the first society in this country, and probably in the world, which, by its own unaided resources, established this great fostering agent of the mechanic arts. Her example has since been followed by societies at New York, Boston, Manchester, Leeds, Dublin, Baltimore, and Washington.

* London Art Journal. 1851.

Like the associations from which they spring, they are now generally considered as the necessary incident and legitimate exponent of every manufacturing and mechanical community.

It is to the "Society of Arts," of London, whose origin and early history we have already traced, that the world is indebted for an exhibition in which the mechanical industry of all nations was represented. The design of the great fair of 1851, at Hyde Park, was entrusted to a local committee of that Institute, in June, 1845; and, after great exertion, they succeeded, with the aid of Prince Albert and the Royal Commissioners, in completing their work on the 1st of May, 1851. That exhibition was but a development of our own annual expositions; yet, when we regard its extent, magnificence, and results, it cannot but be viewed as the most remarkable event of modern times.

A space of nineteen acres in Hyde Park was enclosed, and covered by a building 1848 feet long by 408 feet wide, and 108 feet high in the centre. The cost of this structure was $713,900. The value of the articles exhibited was about twelve millions of dollars. Forty nations contributed to the exhibition, and over six millions of people visited it. From Norway, on the North, down to the Cape of Good Hope, on the South; from China, in the East, to Chili, in the West; from Ancient India and Egypt; from Moslem Turkey; from Guinea, on the Coast of Africa; from New Zealand, in the South Pacific; and from the solitary isle of Malta, they were there. *Then*, for the first time, was witnessed the spectacle of ships of war discharged of their armaments, and converted into transports of the mechanic arts. *There*, for the first time in the history of the world, the authorized representatives of thirty nations were assembled on a foreign soil, commissioned on no hostile errand, on no ordinary diplomacy. There, for the first time since the Crusades, were the nations of Europe allied together for a purpose which religion deemed worthy of its sanction.

Surely it seemed that the sword was about to be beaten into the ploughshare, and the art of war to be no longer learned by men. When the Royal Commissioners resigned their commission at the inauguration, the chairman announced the object of their work to be to conduce to the common interests of the human race, by encouraging the arts of peace and industry, and strengthening the bonds of union among the nations of the earth; and to promote a friendly and honorable rivalry in the useful exercise of those faculties which have been conferred by a beneficent Providence for the good and the happiness of mankind.*

Thus we have seen how science and art, united together, have in times past advanced. Let us turn to the future. A striking lesson which the progress of the arts at the present day teaches us is, the high social position which those engaged in mechanical pursuits are assuming throughout the world. As illustrative of this, I need only refer to the fact that in France, the medals awarded to Frenchmen, at the Hyde Park Exhibition, were distributed by Louis Napoleon in person; and the decoration of the Legion of Honor conferred upon the most successful exhibitors. The Grand Duke of Tuscany has recently, with great pomp and ceremony, established a new order of honor, called the order of "Industry." And aristocratic England has, at length, discovered that it is high time to abolish

* Official Report of Royal Commissioners, at opening of Hyde Park Fair.

the distinction between the industrial and the, so called, learned professions. An eminent fellow of the Royal Society lately held this language: "Industry, to which England owes her success among nations, has never been raised to the rank of a profession. For her sons there are no honors, no recognised or social position. The restriction of learned honors to three recognised professions, has a lamentable effect, both on the progress of science and industry. Its consequence is, that each profession becomes glutted with ambitious aspirants, who, finding a greater supply than demand, sink into subordinate positions, becoming soured and disappointed, and, therefore, dangerous to the community. Raise industry to the rank of a profession; give to your Industrial Universities the power of granting degrees involving high social recognition to those who attain them, and you will draw off the excess of those talented men to whom the Church, the Bar, and Medicine, afford only a slender chance of attaining eminence."*

American mechanics, however, need neither legions of honor, orders of industry, or learned titles. The position which they may attain was fixed at an early day. It was fixed when the Philadelphia printer, in 1776, sat with Jefferson and three others to draft the Declaration of Independence; when the same printer signed the treaty of 1778, by which, for the first time, America was recognised as a nation of the earth; when, amid the splendor of the French Court, kings, royal beauties, and learned savans vied with each other in doing homage to the same printer, the conqueror of the forked lightning, our own Franklin. American mechanics know how largely they have contributed to the formation, wealth, and prosperity of this republic; that the want of a government which should protect and render uniform their interests, was a main cause of the adoption of the present constitution; that from that time down to the present, their interests have given rise to our great national questions, our division of parties, and have elicited the highest eloquence of our statesmen. They know that the genius of this government, which recognises no titled distinctions, will accord to the exertions of their right arms, and of their intellects, their full meed of social reward.

Another, no less striking, lesson taught us is the great conflict going on throughout the world for precedence in the mechanic arts; and that those nations which would win the struggle must render science more and more subservient to art—that practice and science must join together in a more solemn union. England was forced to admit that France had beaten her, and on her own soil. Eminent Englishmen conceded that France had surpassed them in the display of mechanic arts at Hyde Park. No sensible man doubts where the cause of France's victory lies. That it lies in her Central College of arts and manufactures, at Paris, in her School of mines, in her Conservatory of arts and manufactures, and in her Industrial Colleges at Ange, at Chalons, and at Aix, where hundreds, nay, thousands, of the most intelligent French youth are annually educated in the practical application of science to the mechanic arts and manufactures.

The nations of Europe have looked to this with deep anxiety, and are rousing themselves to the contest.

*Tract "On the National importance of studying abstract Science, with a view to the healthy progress of industry, by Lyon Playfair."

England thus speaks by Playfair, one of her Commissioners at the Exhibition of 1851: "All European nations, except England, have recognised the fact that industry must, in future, be supported, not by a competition of local advantages, but by a competition of intellect. Their thinking men have proclaimed it; their Governments have adopted it as a principle of State, and every town has now its schools, in which are taught the scientific principles involved in manufactures; while each metropolis rejoices in an Industrial University, teaching how to use the alphabet of science in reading manufactures aright. Were there any effects observed in the Exhibition from this intellectual training of their industrial populations? The official reserve necessarily imposed upon me as the Commissioner appointed to aid the Queen need exist no longer; and from my personal conviction, I answer without qualification in the affirmative. The result of the Exhibition was one that England may well be startled at. Wherever, and that implies almost every manufacture, science or art was involved as an element of progress, we saw, as an inevitable law, that the nation which most cultivated them was in the ascendant. Our manufacturers were justly astonished at seeing most of the foreign countries rapidly approaching and sometimes excelling us, in manufactures, our own by hereditary and traditional right."*

The illustrious Liebig proclaims from the continent, "that the great desideratum of the present age is practically manifested in the establishment of schools, in which the natural sciences occupy the most prominent place in the course of instruction. From these schools a more vigorous generation will come forth, powerful in understanding, qualified to appreciate and to accomplish all that is truly great, and to bring forth fruits of universal usefulness. Through them the resources, the wealth, and the strength of empires will be incalculably increased."

The venerable Humboldt, with almost inspired authority, thus counsels: "The most superficial glance at the present condition of European States shows that those nations which linger in the race cannot hope to escape the partial diminution, and, perhaps, final annihilation of their resources. It is with nations as with nature, which, according to a happy expression of Goethe, knows no pause in ever increasing movement, development, and production—a curse ever cleaving to standing still.

"Nothing but serious occupation with chemistry and natural and physical science can defend a State from the consequences of competition. Science and information are the joy and the justification of mankind. They form the springs of a nation's wealth, being often, indeed, substitutes for those material riches which nature has in many cases distributed with so partial a hand; those nations which remain behind in manufacturing activity, by neglecting the practical application of the mechanical arts and of industrial chemistry, to the transmission, growth, or manufacture of raw materials; those nations, among whom respect for such activity does not pervade all classes, must inevitably fall from any prosperity they may have attained, and this, by so much the more certainly and speedily, as neighboring States instinct with the power of youthful renovation, in which science and the arts of industry operate to lend each other mutual assistance, are seen pressing forward in the race."

* Lecture before the Society of Arts, on results of Exhibition of 1851.

In this great struggle between the nations of the earth, what position are American mechanics to assume? Will they scorn these admonitions, and disregard these lessons of experience? Will they not rather call upon science to gird up her loins, and to strike for them in the battle?

In what manner the colleges and schools of our country have been, or may now be, accommodating themselves to this new state of things, it would be presumption in me to say. But I may be excused, perhaps, in addressing a word to the men of my own age, and to younger men, on the facilities afforded by the organization of this Institute to carry out the principles of the great mechanical progress going on around us.

Elementary science, the practical development of scientific principles in organized machines and processes, and prompt information as to the advancement of scientific discovery, here and abroad, constitute the proper basis of study for the formation of mechanical intellect. To provide these, the organization and resources of the Franklin Institute are amply sufficient. Its annual course of lectures on elementary science, by professors of acknowledged ability; its large collection of treatises on theoretical and applied science; its committee meetings of learned professors, of experienced practical mechanics, of engineers skilled in mining and metallurgy, of practical chemists, versed in the processes of the arts; its monthly receipt of the scientific journals of this country and of Europe, and its own monthly journal and review—these are its means of usefulness, and to all these the members of the Institute have free access. If the words of Playfair, Liebig, and Humboldt be true, if our daily experience and if our common sense do not deceive us, a proper use of such means cannot fail to advance the mechanical intellect of our community, and better fit us for the great national conflict, now and hereafter to be witnessed.

To all who are interested in the progress of the arts and manufactures of our country, the eloquent appeal of Sir Humphrey Davy addresses itself with force:

"You have excelled all other people in the products of industry. But why? Because you have assisted industry by science. Do not regard as indifferent what is your true and greatest glory. Except in these respects, in what are you superior to Athens and Rome? Do you carry away from them the palm in literature and the fine arts? Do you not rather glory, and justly, too, in being, in these respects, their imitators? Is it not demonstrated by the nature of your system of public education and by your popular amusements? In what, then, are you their superiors? In everything connected with physical science, with the experimental arts. These are your characteristics. Do not neglect them. You have a Newton, who is the glory, not only of your own country, but of the human race. You have a Bacon, whose precepts may still be attended to with advantage."

We have a Franklin. He trod the path of Bacon and of Newton; he reached the same pre-eminence. Amid his daily toil as a mechanic, he struggled up the steep ascent of science. The labor of his hands abated not the vigor of his intellect.

Loiter not in the path which these great men have opened, lest you be overtaken and vanquished in the strife. Say, rather, that their precepts shall be attended to, and their example followed.

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